

ACRP

REPORT 52

Wayfinding and Signing Guidelines for Airport Terminals and Landside

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ACRP REPORT 52

**Wayfinding and Signing
Guidelines for Airport
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AIRPORT COOPERATIVE RESEARCH PROGRAM

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The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

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FOREWORD

By Marci A. Greenberger

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ACRP Report 52: Wayfinding and Signing Guidelines for Airport Terminals and Landside provides an up-to-date single resource for airport operators to consult as they review, update, enhance, or develop their airport wayfinding and signing plan. The guidelines focus on four areas of the airport: (1) roadways—both on-airport, and off-airport access roads; (2) parking; (3) curbside and ground transportation; and (4) terminal. In addition, the guidelines discuss developing a wayfinding strategy; the use of technology and visual displays; and color, fonts, and sizes. These guidelines are a handy resource for airport planners, consultants, and those specifically responsible for maintaining an airport wayfinding and signing plan and signage.

There has not been a single resource to help airports in their wayfinding and signing strategy and plan that includes both roadways and terminals. The industry came together via the professional associations to create guidelines that focused on the terminal, but they were last updated in 2001. The Federal Highway Administration's Manual of Uniform Traffic Control Devices (MUTCD), while applicable to airports with respect to roadways, doesn't specifically speak to airports or the unique operating environment.

Gresham, Smith and Partners was retained under ACRP Project 07-06 to develop a single resource that will update the wayfinding and signing guidelines, and address terminal areas, curbside and ground transportation, parking and on-airport roadways, and off-airport access roads. Updates include ADA issues, ensuring compliance with the MUTCD, and the increase in common use technologies. The result of their efforts is *ACRP Report 52: Wayfinding and Signing Guidelines for Airport Terminals and Landside*.

Some elements of the guidelines include: how to develop a wayfinding strategy and an explanation of "why"; discussion of font and legibility issues; and a number of real world examples to assist the reader when applying the concepts to their airport.

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Introduction

There are many definitions of wayfinding, but in the most basic terms it is simply the act of finding your way to an intended destination. Therefore, by extension, the purpose of this guideline is to provide airports with the tools necessary to help passengers find their way in and around the airport. The content contained in this guideline is based on research, surveys from airports and design professionals, existing guidelines, and case studies.

1.1 Background

The hub and spoke system instituted by the airlines often requires travelers to transit through intermediate airports in addition to their origin and destination airports. The result is that there are many people in the airport terminal that may not be familiar with the terminal layout or the location of gates and other facilities. It would be helpful to passengers, as well as meeters and greeters, if airports had wayfinding and signing systems that were based on uniform guidelines.

Currently, there is no single document or guidebook available to airport operators illustrating best practices for wayfinding and signing the airport terminal and landside. Specific guidelines for wayfinding for the airport terminal and landside, other than some related to signs, are not readily available. These guidelines, where they do exist, are in the private domain of consultants or individual airport operators.

The most recently published guideline for airport signs, *Guidelines for Airport Signing and Graphics, Terminals and Landside*, was originally published in 1986 and last updated in 2001. It was prepared in conjunction with representatives from the Air Transport Association (ATA), American Association of Airport Executives (AAAE), Airports Council International—North America (ACI-NA), and Airport Consultants Council (ACC). The most recent edition of the Federal Highway Administration's Manual of Uniform Traffic Control Devices (MUTCD) prescribes the design or color of airport roadway signs. Previous editions of the MUTCD did not address airport roadways, and it is not clear to what extent the input of airport operators or their representatives was sought during the preparation of the latest MUTCD.

While several large airport operators have established graphic standards and maintain and update these standards on a regular basis, not all airport operators have the staff or resources to do so. The overall problem of non-standard signing practices at airports across the country and across the world still exists. The increasing number of airport users in the United States combined with the evolution of terminal design as well as the wide range of airport sizes and configurations make the wayfinding more complex than ever before. The needs, problems, issues, and solutions can vary greatly between the airport roadway and the airport terminal.

This report will provide airport operators with an updated guideline for wayfinding and signing for airport terminals and landside. By adopting these guidelines, the travelling public will

recognize the benefit of experiencing a transparent system of wayfinding and signs as they use the airport terminals and their landsides.

1.2 Historical Perspective

Prior to the research that led to ACRP Project 07-06, “Wayfinding and Signage Guidelines for Airport Terminals and Landside,” there was a previous guideline originally developed in 1984: *Guidelines for Airport Signing and Graphics*. Before looking forward, it is appropriate to include a historical perspective and review the events that led to where we are now.

During the 1960s and through the mid 1970s, airport signing and graphic systems were designed to be predominantly permanent installations. This was due in large part to the relative stability in the aviation industry regarding which airlines served which airports combined with infrequent route changes. With certain airlines as fixtures at specific airports, the airlines themselves had a very strong influence on terminal design and signage. Terms like “Baggage Claim” and “Boarding Area” found their way into the vernacular and soon became standards in the language of airport signage. Additionally, airline permanency made the use of premium materials for sign systems more economically feasible. These higher-end materials often had an ancillary benefit of reduced maintenance and repair costs over the life of the sign, which meant signs—and terminology—that were designed to last.

However, when President Carter signed the Airline Deregulation Act on October 24, 1978, the status quo was altered radically. With the stroke of a pen, airlines were now able to enter and exit airports with relative ease. The aggregate efforts of each airline’s dynamic changes in “testing the market” (expansion or contraction in the number of cities served coupled with frequent relocation within the airport terminal complex) required substantial and continual changes to sign systems throughout most of the nation’s airports. As a result, the cost associated with maintaining an effective informational signage system increased dramatically and, despite best efforts to the contrary, the traveling public was often left to navigate through inconsistency and confusion.

To help rectify this situation, a joint aviation industry Airport Signing and Graphics Task Force was established in March 1982. This task force—led by Joseph Erhart, then manager of corporate design for Republic Airlines, and comprised of representatives from ATA, AAAE, and ACI-NA (then known as the Airport Operators Council International)—accepted the assignment to investigate the state of the industry and develop a reference guide that would inform airport operators, airlines, and consultants of economical and practical signing methods to be applied to various aviation facilities.

In order to make this effort a more comprehensive and authoritative document, the task force requested and received valuable assistance and input from professionals in the design community: sign manufacturers, the Society of Environmental Graphics Designers (SEGD), the American Institute of Graphic Arts (AIGA), the Institute of Transportation Engineers (ITE), the Institute of Transportation Studies (ITS), the Federal Aviation Administration (FAA), and the Civil Aeronautics Board (CAB). For 2 years, these individuals played a key role in helping to create a publication that would help the aviation industry reduce costs, increase flexibility, and provide a more uniform information system to assist the traveling public. The resulting publication—representing the philosophical consensus of everyone involved—entitled *Guidelines for Airport Signing and Graphics* was first distributed in September 1984.

Over the years, *Guidelines for Airport Signing and Graphics* has been updated twice (1994 and 2001) to maintain its relevancy in the midst of an ever-changing and increasingly complex industry. The contents of the previous publication included guidelines and design criteria for developing practical, functional, and flexible airport signing and graphics systems.

The goal of that document was to be used as a guide in helping to create uniform national air transportation standards in airport signing and graphics. The previous guideline also aimed to heighten the reader's awareness of the complexity of factors that go into the planning, design, and development of a successful signing and graphics program.

While the ACRP Project 07-06 provides the current best practices for the aviation industry, the previous guideline still contains valid information and can continue to serve as a valuable tool. Further acknowledgments related to this manual may be found in the Appendix, pages A1.1 and A1.2 of the *Guidelines for Airport Signing and Graphics*.

1.3 Purpose of the Guidelines

For the most part, the wayfinding experience in an airport environment is a self-guided journey. Airport environments can create some very complex navigational challenges. Therefore, the role of a well-planned wayfinding system is quite extensive.

The objective of ACRP Project 07-06 is to develop a guideline for airport operators containing up-to-date wayfinding and signing guidelines for the airport terminal and landside. **The purpose of the guideline is to facilitate the safe and efficient movement of passengers within each airport and from one airport to another through the uniform application of wayfinding best practices and common design criteria.** The guideline addresses the following areas:

- On-airport roadways/off-airport access roads;
- Parking;
- Curbside/ground transportation; and
- Terminal, including concourses/gates, ticketing/check-in, security checkpoints, federal inspection services, baggage claim.

These guidelines also include a systematic process for evaluating an airport that will ultimately yield improvements in the passenger wayfinding experience by understanding the sometimes elusive factor of 'why' passengers get lost. By taking time to understand the 'why,' an airport will be able to develop their own wayfinding strategy that works to meet their specific needs.

1.4 Organization of the Guidelines (How to Use)

The guideline's organization is focused on the four primary areas of the airport as stated within the project's objectives—Roadway, Parking, Curbside and Terminal. This organization allows an airport to isolate sections of the new handbook (e.g., Terminal) and be able to adequately find the guidelines and standards for that need without searching the whole document.

In addition to the sign components related to general guidelines, the guideline includes case studies from large, medium and small airports that illustrate the best aviation wayfinding principles and practices that can be adapted and applied as they relate to the end user's needs.

Chapter 2 is an overview of the signing and wayfinding process that begins with the wayfinding analysis, followed by how to develop a wayfinding strategy. Chapters 3, 4, 5, and 6 contain signing and wayfinding guidelines specific to roadway, parking, curbside/ground transportation, and the terminal. Each of these chapters shares common information such as design elements and accessibility. To avoid being unnecessarily redundant the specific details associated with design elements and accessibility are concentrated into Chapter 6—Terminal. Chapter 7 focuses on technology and communications. Chapter 8 lists applicable codes.



CHAPTER 2

Signing and Wayfinding Process

2.1 Introduction

A guidebook can only cover a certain level of detail and inevitably an airport will encounter a wayfinding challenge that is not specifically addressed. This chapter is written to help airports understand the “why” that drives the “what” by providing the tools to help them understand the signing and wayfinding process and to enable them to develop a wayfinding strategy that works for their specific needs.

Part one beginning in Section 2.2 covers the analysis aspect of the signing and wayfinding process. Part two begins in Section 2.3 and details the three steps for developing a wayfinding strategy:

- Buy-in (value),
- Philosophy, and
- Logic.

The subjects of wayfinding philosophy and logic can be somewhat abstract, so these sections include simple analogies to help illustrate some key concepts. This chapter will also help an airport understand how to deal with the following two issues:

- **Changes:** There is a tendency to focus only on the extent of the changes, but airports also must understand what the true impact zone is.
- **Complaints:** There is a temptation to try and just fix the problem area, leading to tunnel vision. The airport really needs to determine how this problem area fits into the overall wayfinding system.

Continuity and connectivity are the two key principles covered in this chapter that can truly help airports solve problems and perpetuate the integrity of their wayfinding system.

2.2 Analysis

2.2.1 Establishing Need: Considering Users in Design

In order to ensure that airport users can comfortably and successfully navigate from the roadways to the airport gates, roadways, buildings, and signs must be designed with their needs in mind. Effective signing begins with airport layout. Airport and building layouts that organize destinations in simple and logical ways require less and simpler signing than those with more complex layouts. Building layouts that are organized according to user expectations (e.g., check-in counters are accessed just beyond the entrance) require less signing than those that violate expectations with unusual layouts.

An effective signing system is one that has been designed with the users' physical, perceptual and cognitive needs in mind. A systems analysis approach, described herein, ensures that the majority of user needs with regard to wayfinding will be appropriately accommodated.

2.2.2 Systems Analysis Approach

A systems analysis approach to the signing process considers the following:

- The goal of the system,
- All user categories,
- User tasks,
- Information needed to carry out those tasks,
- User characteristics and limitations (and how those affect information presentation), and
- Potential errors made by users.

2.2.3 Goal of Signing System

An appropriate goal for an airport signing system would be to ensure safe, convenient and efficient access for all users to and from nearby roadways and arterials to all areas within the airport terminals and parking facilities.

2.2.4 Airport User Categories

With respect to users, there are many categories to be considered in an airport setting. These include the following:

- Unfamiliar passengers or drivers picking up or dropping off passengers,
- Familiar passengers or drivers picking up or dropping off passengers (when changes are made),
- Passengers with disabilities of various kinds,
- Non-traveling visitors who are there to greet/send off passengers,
- Ground transportation drivers,
- Delivery drivers, and
- Airport employees.

Each category of user must be systematically considered to ensure all origin-destination signing needs have been included in the planning and design of the signing system.

2.2.5 Structuring the Signing System

Sign content is determined by the wayfinding tasks that must be carried out by each user category. First, the most common wayfinding chains should be determined for each airport user category. For unfamiliar passengers, the most important wayfinding chain will start with a nearby roadway or arterial and proceed to the desired terminal and arrivals level, up to arriving at the gate. Wayfinding chains must be considered from each direction (e.g., from the airport gate back to the roadway).

To avoid overloading users with information, a hierarchy of destinations is used. For example, typically baggage claim and ground transportation are signed for arriving passengers at the gates. Based on experience, most passengers will expect to find information about the airport exit, rental cars, taxis, limos, buses and parking once they reach baggage claim. A simple hierarchy of guiding passengers from the gate to baggage claim and ground transportation can simplify the number of messages without having to use a comprehensive list that creates information overload. Using such signing hierarchies, as long as they are anticipated by users, greatly simplifies

signing by providing information on a need-to-know basis. The wayfinding chains assist in identifying the hierarchy of destinations.

Sign systems within any one area of the airport (e.g., roadways, parking garage, terminal) should be standardized with respect to terminology, lettering style, location and meaning of color. When users are confronted by a complex environment, they are more easily able to locate sign information if it is presented in a consistent format.

2.2.6 Considering User Limitations in Sign Design and Location

Airport users have visual and cognitive limitations that impact the design of signs and should be considered to ensure signs are effective. Effective signs require human factors expertise in development and testing in order to meet the following requirements:

Conspicuous. The color and light on the signs contrast with their background so they are easily detected from the sign's surroundings. Signs should also be located where users expect to find them.

Concise. Passengers are unlikely to spend more than a few seconds trying to extract information from a sign. Information presented at any one location should be selected in accordance with the destination hierarchy and provided on a need-to-know basis.

Comprehensible. Although the meaning of a sign may be clear to the designer, it may not be clear to airport users. To ensure comprehension of symbol signs and many text signs, evaluation with representative users is required. (Note: members of the design team or anyone familiar with the sign design project cannot be considered to be "representative users"). Symbols may be in wide use, yet poorly understood. For example, various arrow shapes are used and directions "straight ahead" versus "go up one level" may be confused. Comprehension of map display signs is improved if they are oriented to be read from the same perspective as the viewer.

Legible. Signs should be comfortably legible at the distance at which the user is first likely to look for them. A user with 20/20 vision can barely resolve sign information at 58 feet away for each inch of letter height. A more reasonable expectation, given a range of visual capabilities and non-optimal contrasts or lighting, would be 40 feet for each inch of letter height. The MUTCD recommends using 30 feet of legibility distance for each inch of letter height as a design goal. To be comfortably legible, text needs to be much larger than this. For complex displays (e.g., terminal maps), the use of the sign by several users at once should be considered, so that the text is comfortably legible from the distance a user is likely to stand.

Location. The various pathways to reach an area must be considered. There can be a number of entrance doors to a terminal and check-in counter information should be visible from each, with a minimum amount of walking and searching for it. Signs must be located at decision points where the user has the option of taking different paths. Signing on roadways is much more challenging because of the speed at which the user is moving. The same requirements discussed herein apply, but information load and location of signs is much more critical. User requirements for signs intended for drivers are discussed in more detail in Chapter 4.

2.2.7 Evaluation Methods

There is increased interest in the level of service (LOS) provided to passengers, with an overall goal to better align airport operations with the expectations of users.

A number of methods can be used to evaluate a wayfinding system. The following are four approaches:

- **Ergonomic Sign Assessment:** Signs representative of the entire signing system are evaluated with respect to conspicuity, legibility, information load, comprehension, and placement.



Importance of Wayfinding

"Studies consistently show the importance of wayfinding and give it significant weight with respect in the determination of the overall LOS of the terminal. Regression analysis by Correia et al. (2008), for example, produced results showing that wayfinding was the third most important of 10 LOS variables considered—scoring higher than check-in and departure lounge. Similarly, de Barros et al. (2007), when considering transfer (connecting) passengers, found wayfinding the fourth most important of 21 variables"¹.

This research is significant because it validates how wayfinding in an airport affects the passenger experience and supports the need to properly evaluate the wayfinding experience.

The ergonomic assessment would establish the major wayfinding chains and then evaluate signs along the route with respect to the qualities noted. The wayfinding chain concept is introduced in Section 2.3.3.3.

- **Frequently Asked Questions Survey:** When passengers experience wayfinding difficulties they are likely to ask airport or concession staff for help. Both airlines and concessionaires benefit from good signing. Interviews with staff can be used to identify the most common wayfinding questions in each area of the airport. Key staff (e.g., official airport volunteers) can be given a list with the most common questions (this reduces workload for staff assisting in the survey), and can tabulate the number of times these questions are asked over a defined period. Any additional questions can be added as they are asked. Frequently asked questions will assist in identifying signing problems. Any FAQ survey must record time of day and date since type of questions may be dependent on both. (See Appendix A for a sample FAQ survey.)
- **Task Analysis:** Major wayfinding chains would need to be established. People unfamiliar with the airport, but potential passengers, would be recruited and asked to travel to various destinations within the airport accompanied by a researcher. A verbal protocol would be used whereby each participant would voice their thoughts as they carry out the wayfinding tasks, giving the researcher insight into where and why wayfinding problems occur.
- **Survey of Unfamiliar Passengers:** Unfamiliar passengers willing to fill in a survey could be recruited in the parking garage before they enter the terminal. The survey would be collected at the gate. The questions should focus on where along the journey the participant was not confident about their path or where they got lost, where they looked for and could not find specific signs and where they had to ask someone for directions. (See Appendix A for a sample FAQ survey.)

In each of these methods, step one is to determine the survey objective using a sound system of developing and evaluating questionnaires with the sole purpose of evaluating the wayfinding system.

These wayfinding evaluations will determine what corrective action(s) may be necessary. The list of corrective actions can be prioritized in one of several ways:

- Cost—Least expensive to most expensive
- Time—Short-term solutions versus long-term solutions
- Benefit—What level of improvement will each change yield

 **CASE STUDY**
Developing and Evaluating Questionnaires

Questionnaires were administered to determine how passengers at Calgary International Airport (YYC) were concerned about ease of wayfinding and about their preferred methods of navigation. The questionnaire was developed in three stages during the collection of data. It consisted of five, seven or eight questions. Although five questions were similar for all those surveyed, there were additions on the later questionnaires. Questionnaires were administered after subjects had been told about the study and asked if they were willing and able to complete the questionnaire.

Figures 2.1 and 2.2 show the results from the survey at YYC.

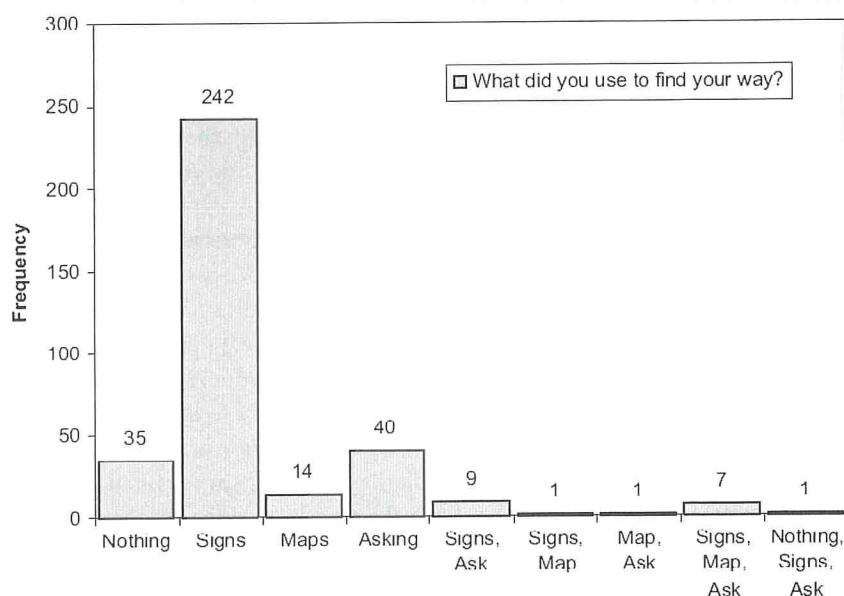


Figure 2.1. Wayfinding aids used at YYC.

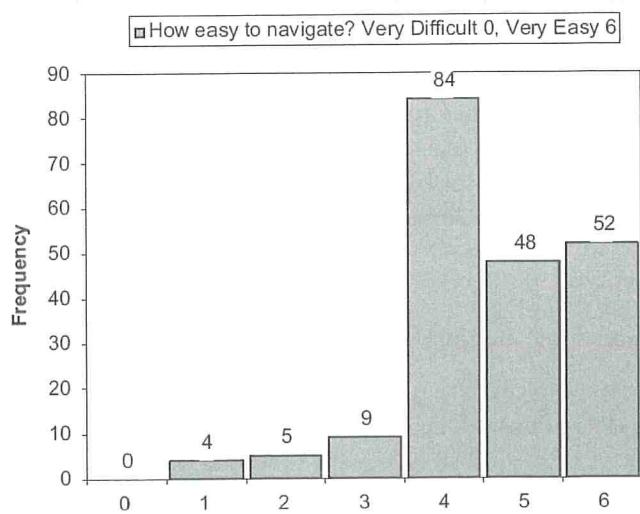


Figure 2.2. Perceived ease of wayfinding at YYC.

Resources are finite, so by using each of these criteria, an airport should be able to develop an action plan that will provide the best wayfinding value for the capital dollar. If the corrections are minimal, cost may not be an issue and implementation of the changes can be expedited fairly easily. However, if the correction cost is substantial, an airport may be reluctant to make the necessary financial commitment. In this case, a testing period may help.

2.2.8 Passenger Circulation Analysis

2.2.8.1 Information Trees

Passengers should be able to access wayfinding information easily and accurately, so it is important to plan a consistent sign system for each route from roadway to gate and vice versa. To help plan for all of the various wayfinding scenarios, create a circulation tree for departing, arriving and connecting passengers that is specific to your airport (Figure 2.3). Account for the different types of passengers on each circulation tree. For instance, on the departure circulation tree passengers will be arriving by rental car, taxi, limo, shuttle, or mass transit; some will be dropped off and others will self-park. At first, each of these passenger types will be searching for different information, but ultimately will be searching for the same destination—the terminal—from different parts of the airport.

2.2.8.2 Circulation Analysis

A circulation analysis is basically using a site plan or floor plan to plot the wayfinding routes according to the circulation tree exercise (Figures 2.4 and 2.5). The following steps outline this process as it relates to an airport terminal:

- Once each circulation tree is complete, start laying out the arrival route (use green lines); the departing route (use red lines); and other key destinations (to baggage claim, etc.).
- Circle the decision points—a big circle for primary decision points, small circle for secondary decision points.
- Determine how the vertical wayfinding will transfer between levels. Is the elevator within sight of the escalator, for example, without a series of directional signs to the elevator? Depending

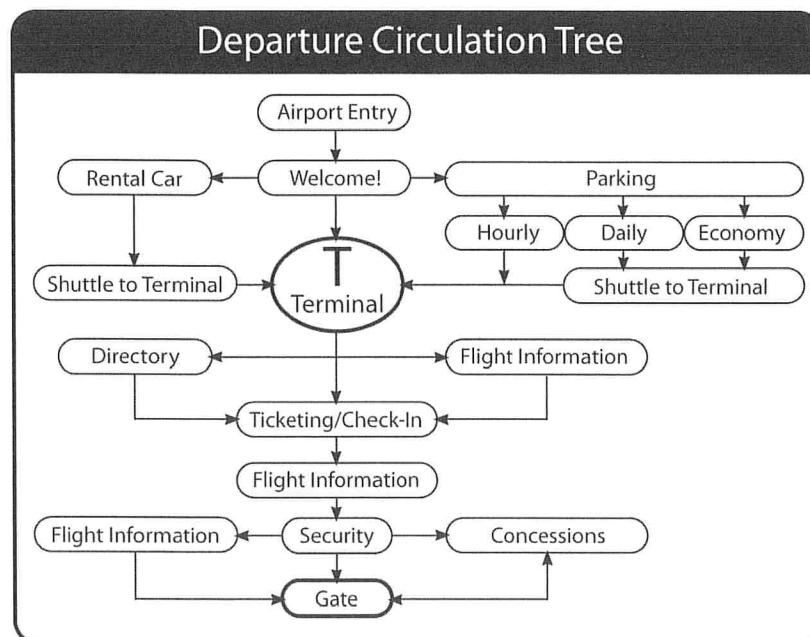
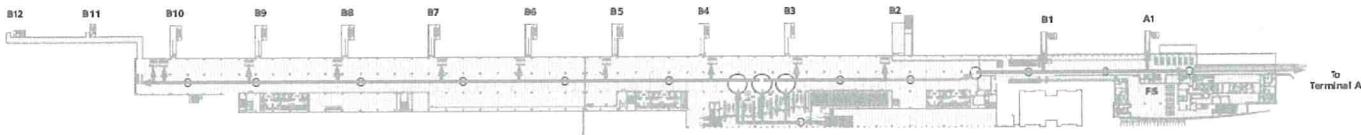
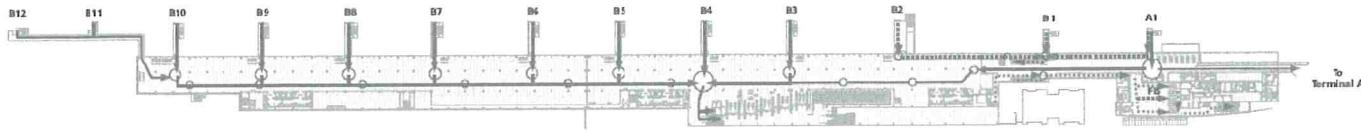


Figure 2.3. Typical circulation tree for departing passengers.



Source: Mineta San Jose' International Airport.

Figure 2.4. Circulation analysis diagram: departures level 2—terminal B at San Jose International Airport (SJC).



Source: Mineta San Jose' International Airport.

Figure 2.5. Circulation analysis diagram: arrivals level 2—terminal B at SJC.

on the complexity of the terminal architecture and the wayfinding route, it may be difficult to follow on a simple floor plan. While it requires additional effort preparing a series of floor plans, using an axonometric view will provide a complete overview of the terminal.

- Before placing any sign locations, consider the use of architecture to facilitate the wayfinding. For example, architectural treatments may be used to identify a decision point and reinforce the wayfinding.
- Place each directional sign according to the decision points (circles on the plan). Review the architecture context including understanding ceiling heights and conditions.
- Look for any particularly troubling wayfinding decision points, where you must establish a clear zone around the sign that prohibits other visual graphic elements, including advertisements and art.
- Review the viewing distances between decision points and determine if any additional signs are required. Regular spacing reinforces consistency and builds on passenger confidence and expectancy.
- Check visibility.
 - Will it be easy to see the sign from afar?
 - Are there other elements that impact the visibility of the sign?
 - Consider the placement of other signs to avoid creating visual clutter.
- Calculate the necessary letter height for minimum legibility requirements and then determine the sign panel sizes.
- Review lighting requirements. If the sign system is not illuminated, understand the ambient lighting levels, both day and night, where signs are needed.
- Identify locations of directory maps or flight information displays.

These steps can be applied to a new sign system or in an existing sign system; or they can be applied in an existing terminal or new construction.

2.2.9 Evaluation of Current Wayfinding System

Solving a complex wayfinding problem is not an easy task, and a major driver in any solution is cost. So how does an airport determine the best wayfinding value for their design dollar? If passengers are constantly lost or confused it is easy to think the existing wayfinding system is broken and should be replaced. It would be easy to recommend a new airport-wide sign system. While this is certainly a valid approach that will likely yield positive results, a total sign replacement requires substantial time, effort and resources. Of these three factors, cost typically has the biggest impact and not every airport will have the necessary capital funds to make global changes to their wayfinding system. Is there a better value approach available?


CASE STUDY

Evaluating Existing Sign Systems

Amsterdam's Schiphol Airport demonstrates how carefully planned design can lead to a successful wayfinding system. The sign system's design was installed in the 1960s, and since that time the airport had added new terminals and extensions. The project manager sought help from Bureau Mijksenaar in 1990 to update and expand the signage. The common question that many airports face is whether to replace the sign system or work with the existing sign system. The firm spent a year taking inventory and finding the existing system's strengths and weaknesses. By keeping the strong points of the existing design, it provided continuity for the passengers. The evaluation of the existing sign system updated the color-coding function, added symbols, and made some terminology changes. This improved the sign system while maintaining the feel of the old one, but with a more sensible approach.

Before a decision is finalized, it may make sense to evaluate the existing sign system to separate perception from reality. For wayfinding inside terminal areas, there is a checklist in Section 6.1.1 that outlines step-by-step the key elements to evaluate. Similar checklists can be developed to analyze other airport areas such as roadway, parking, and curbside.

The concept behind the value approach is simple: build on what works and fix what does not. Conducting a wayfinding analysis will help evaluate just how extensive the wayfinding problems really are and what level of effort is required to correct them. Evaluate the corrections from a cost perspective. The number one factor is location. If the majority of signs are in the right place and in good condition then it is worth considering a value approach taking advantage of the existing sign infrastructure to save both time and money.

After inventorying all of the signs, evaluate the signs by asking the following questions:

- Are they in the correct location?
- Do they need to be relocated?
- Do they need to be removed?
- Are any missing and need a new sign added?
- Do they need to be revised?

Assign a dollar value to each of these above conditions and then compare this cost with a comprehensive sign replacement.

Plans for airport growth and expansion should also be factored in the decision to either replace the signs in the existing areas or perpetuate the existing sign system standards into the new areas of expansion. The goal should strive for the consistent application of the sign standards airport-wide. Too often a new terminal will generate a new look for the wayfinding system, without considering the current wayfinding in the existing airport area. The result conveys an inconsistent visual message to the passenger.

2.2.10 Asset Management

Airport operators often view their wayfinding system as consisting only of signs which are installed and subsequently ignored. In reality, an airport rarely operates in a static mode. Subsequently a frequently overlooked aspect of information systems is asset management. Implementing

a comprehensive wayfinding program is a substantial investment, so an airport needs a strategy to protect their investment because new services and tenants are always coming and going.

The goal of an asset management plan is to perpetuate the integrity of the wayfinding system. If the wayfinding system is not updated, it becomes an obstruction to passengers trying to find their way because the inconsistencies will make all information elements suspect. More often than not, a comprehensive wayfinding overhaul is the result of years of neglect.

Along the same lines, when changes are made, they should conform to the design standards set forth in the existing system. If the existing system is being replaced, it should be taken out entirely. Different types of signs confuse users who are unsure of why there are two systems, if each style has a specific purpose, or if one type of sign is wrong.

2.2.10.1 *Information Database*

The number of signs at a medium-sized airport can easily reach into the thousands. In order to keep up with this amount of information, an organized and logical database system is required. Some airports maintain and service their sign needs in-house. Other airports contract out-of-house. At very large airports it can even be a combination of both. Regardless of the approach, the airport must assign ownership of maintaining an accurate database. It is the key to successfully perpetuating the integrity of the wayfinding system.

2.2.10.2 *Monitoring the Equation*

Part of maintaining the integrity of the wayfinding system also requires ongoing supervision and monitoring. Utilize periodic surveys to analyze the airport's strengths and weaknesses through the following methods:

- Segment by passenger experience, roadway, parking, curbside or terminal.
- Segment by demographics (e.g., age or gender).
- Conduct specific surveys about problem locations.
- Use employee observations and feedback from volunteers.
- Ask business partners for feedback.

2.2.11 *Future Considerations*

The physical component of a wayfinding system does have a lifespan. Exterior applications that are subject to the sun and weather will require more maintenance and ultimately need to be replaced sooner than the interior wayfinding applications. Because the sign component of the wayfinding system is a capital investment, airports need to evaluate their sign systems and plan their budget accordingly.

2.2.12 *Temporary Signs*

Airports that are undergoing a construction project will require temporary signs at some point during the process. The primary goal for temporary signs is to maintain the credibility of the wayfinding system.

The points to keep in mind for temporary signs in addition to the existing signs are the following:

- Use the same design standards as the permanent signs to maintain a consistent image for the airport.
- Understand the temporary signs may need to be larger and more visible to compensate for the disruption.

- Ask how long the temporary signs will be in service to determine what materials are required to maintain a good appearance throughout the construction period.
- It is easy to overlook particular passenger needs so plan carefully to make sure the wayfinding chain is not broken during construction.

With respect to construction phasing and temporary signage, the same guidelines apply as for permanent signs with respect to letter height, terminology, color and content. The only difference would be in the quality of the materials used to fabricate the sign. Once construction is completed, an evaluation of the signing should be conducted to verify that the new signage promotes improved wayfinding.

For temporary signs used in roadway construction areas, Part 6 of the MUTCD includes detailed typical layout drawings for road work areas. Temporary signing should include key destinations such as terminal, parking, rental car return, and airport exit, at a minimum.

2.2.13 Passenger Wayfinding Experience—Additional Thoughts

Customer expectancy—The customer, in this case a passenger, expects to have to find their way through the airport, so they will be looking for the information that will guide them to the correct terminal, parking lot, etc.

Information overload—Information overload is exactly what it sounds like; too much information on one sign and/or too many signs in a given area.

Consequences—The violation of customer expectancies and information overload can be serious.

- On a roadway condition, the consequences are motorists weaving across lanes to avoid missing their turn or making other unsafe movements in traffic because they are not sure where to go.
- In parking and curbside areas, where pedestrians often share the same space with motorists, the potential consequence of an auto-related fatality is a major concern.
- Inside the terminal, the consequence of lost and confused passengers is the risk of a missed flight.

The following are ways to avoid these consequences:

Violation of customer expectancies—Present the wayfinding information in a uniform and standardized manner along with consistent sign placement. Violation of user expectations will result in losing passenger confidence in the airport's wayfinding system, which in turn will create a negative perception.

Information overload—Establish a clear and concise messaging hierarchy combined with consistent application throughout the wayfinding experience from roadway to gate.

2.3 Developing a Wayfinding Strategy

Wayfinding in an airport environment can be extremely complex, so before any planning or design work begins, it is important to develop a strategy for wayfinding.

The following three steps are essential in the development of a sound wayfinding strategy:

- **Step One: Buy-In.** Buy-in from the airport executives is a fundamental and critical step. Because most wayfinding programs fall under an airport's capital expense program, it is important to understand the business value side of the equation and to secure support for

both the initial effort and ongoing commitment to perpetuate the integrity of the wayfinding system.

- **Step Two:** Adopt a wayfinding philosophy. Example: The perception of wayfinding is often thought of simply as a sign. The reality is that each sign communicates information critical to the driver or passenger experience. Therefore, when it comes to planning, designing, and maintaining your airport, what level of emphasis do you place on wayfinding? Ask questions like “Is ‘that’ sign secondary to the advertising that generates revenue?” in order to establish a clear priority for the wayfinding at your airport. In short, wayfinding information should take priority over other types of visual information such as advertising and retail so that they do not adversely affect the passenger wayfinding experience. Therefore, a recommended philosophy is to create specific information zones.
- **Step Three:** Logic. Section 2.3.3 looks at the factors that impact wayfinding as well as the key concepts that drive the development of wayfinding logic, including continuity, connectivity, and consistency. Using the connectivity factor as an example: Multi-level buildings can create complex passenger movements: some paths are unique, other paths will overlap. To avoid creating wayfinding gaps, each path must be mapped and decisions points, identified in a consistent and efficient manner for each type of passenger movement.

The goal for the sum total of these three sections is to provide the knowledge and insight necessary to develop an airport-specific wayfinding strategy.

2.3.1 Buy-In

Before a person is willing to buy something, they usually want to know what the value of the goods or services is. With regards to wayfinding, it can be challenging to effectively measure the value in a tangible manner.

Research studies have developed metrics to evaluate wayfinding. Customer satisfaction surveys are another tool to help measure wayfinding. Last but not least, wayfinding can also be measured in terms of revenue. No matter how you measure the value of wayfinding at an airport, it is a fact that good wayfinding equals improved performance.



Lost Passengers = Lost Revenue

Wayfinding can also be measured as a level of service (LOS). The research studies from Churchill, Anthony, et al. “consistently show the importance of wayfinding and give it significant weight with respect to the determination of the overall Level of Service (LOS) of the terminal. Analysis by Correia et al. (2008), for example, produced results showing that wayfinding was the third most important of 10 LOS variables considered—scoring higher than check-in and departure lounge, two facilities traditionally assigned a LOS measure. Similarly, de Barros et al. (2007), when considering transfer passengers, found wayfinding the fourth most important of 21 variables.”

Airports should understand that the more time passengers spend driving, waiting, walking, or trying to find their destination, the lower the perceived LOS. If an airport takes its role seriously and considers customer satisfaction as a non-disputable requirement, efficient wayfinding should be provided.

Passenger frustration that results from a difficult wayfinding experience creates high levels of stress. Once stress takes over, it takes time for the passenger to recover. In terms of business impact to an airport, this may mean that the passenger prefers to wait at the gate and not return to the food court or retail areas, which equals lost revenue. Lost passengers also ask employees questions, which in turn impacts employee productivity.

2.3.2 Philosophy

Even without all of the supporting research, it is easy to acknowledge that airports can be very complex: both operationally and architecturally. When looking for answers to solve complex wayfinding issues, one challenge is how to physically and visually get your mind around the problem. Whether on an airport roadway system, in a parking garage, curbside, or inside a terminal, the answer is to start globally. Using a terminal area as an example, an airport with multiple levels and buildings, needs to be viewed in a manner that can tie them all together.

Researchers have emphasized the importance of conceptualizing ALL features of the built environment as a wayfinding system^{52, 53}. O'Neill recommends the use of actual observations of wayfinding performance to permit a clearer understanding of how architectural design features influence human performance.

Ideally, preliminary building design discussions should consider the wayfinding system in order to create effective, intuitive architecture that requires less signs and more architectural elements that improve communication and circulation. Additionally, it is equally important to create specific information zones. For example: Wayfinding information inside the terminal should take priority over other types of visual information such as advertising and retail so they do not adversely affect the passenger wayfinding experience.

2.3.2.1 Global Perspective—Begins with Airport Design

Just as there are many factors that affect the design of an airport, there are also many factors that impact an airport's wayfinding system. It is important to understand what these factors are and how they relate.

From a global perspective, the first goal of creating a well-designed signing and wayfinding system begins with the design of the airport itself, because the design of the signs and wayfinding are developed as a direct response to the airport environment. The configuration of the roadways and parking, the relationship of the curbside areas to the terminal, and the architecture and layout of the terminal and gates all have a major impact on the passenger wayfinding experience. Therefore, wayfinding must be integrated at the beginning of the planning process and continue throughout.

Therefore, the designers and engineers involved in the airport planning and design process must first acknowledge, then understand, and finally take into account the impact they have on an airport's wayfinding system. This fundamental philosophy that wayfinding challenges are created by complex built environments was a recurring theme in the development of this guideline and is supported by numerous research studies that document this issue.

The second goal of a wayfinding strategy is to value it. It is critical to think of your airport's wayfinding system as a building system such as the HVAC system, the communication system, the electrical system, etc. All of these systems require maintenance and service in order for your airport to operate efficiently. Your wayfinding system should be treated no differently. This is a very important concept to make part of every airport's culture. In order for the airport's wayfinding to be successful, it must be treated as an integral part of the airport's building systems.

2.3.2.2 *Roadway*

Drivers entering an airport roadway system bring with them all of their experience and expectations about roadway design and traffic control. This experience is gained by driving on conventional roads and highways. The more an airport road can be made to look and function like a regular road, the more it will conform to driver expectations, which will lead to a safer and less frustrating driving experience.

Many airports try to make their roadway signs look like their terminal interior signs to present a unified facility identity. It is important to remember that roadway signs should be considered fundamentally different than interior signs. The users of roadway signs are moving and their attention should primarily be directed toward the safe operation of their vehicle. Drivers will more easily and safely navigate when they can rely on their previous experience with roadway signs. By making airport roadway signs look and feel like other roadway signs, the needs of the driver are better served.

The guidelines developed for this section are primarily based on research and standards for general roadway signing. Since federal and state standards apply to airport roads open to public travel, readers must consult the original source documents for the details of implementation.

2.3.2.3 *Parking*

All areas of signage should be an extension of a global philosophy so that the wayfinding experience is consistent as a person moves from one functional area to another. Granted, the activities being performed in a parking garage are different than those at the terminal curbside, which are different than activities within terminal buildings. Signage for and within each of these facilities, however, should be coordinated so that users learn to anticipate and look for information based on reliable sign placement, messages, colors, icons, etc.

At one time, parking was just a necessary function airports had to provide their patrons, but was little more than an afterthought compared with terminals and runways. Today, parking is one of the largest sources of unencumbered revenue for an airport as well as one of its largest sources of complaints by travelers and employees. Fortunately, signing, as it relates to parking, is now reaping the benefits of both careful planning and technology. Airports (as well as other major transportation hubs) are employing a user-perspective approach where adequate information is delivered at the necessary locations in the appropriate form.

With regards to parking, signage needs to address—if not absolutely separate—vehicle traffic and pedestrian traffic. While a driver needs to either find a parking space or find the exit from the parking facility, pedestrians are attempting to locate themselves and the most direct route to the terminal or back to their vehicle. Signage for each group should be readily identifiable, succinct and repeated so that users receive both directions and confirmation of their travel paths. The more direct and safe the route for both drivers and pedestrians within a parking facility, the less stress and frustration users experience.

2.3.2.4 *Curbside and Ground Transportation*

The terminal curbside is often the most hectic, high-energy, and confusing area at an airport. Although signage cannot overcome physical limitations and geometric difficulties, a well-planned sign system at and along the terminal curbside can boost the efficiency and safety of the space. Airports need to examine regulatory and information signage as a whole and consider the philosophy that less signage may be more useful at the curbside where so much activity is already taking place. The effective management of the limited real estate at terminal curbsides becomes critical, and signage may be the most important factor outside of the physical layout of the area.

This chapter describes signing suggestions for the curbside/ground transportation areas while maintaining an overall design cohesion across the entire airport. The signage discussed is

all exterior directions, identification, and informational signs for public use at the following locations:

- Curbside,
- Departures Drop-off/Check-in,
- Arrivals Pick-up, and
- Ground Transportation Curbsides.

In addition, airports are continually taking a more customer-centric approach to their signage. Regarding this philosophy, negative signs that convey what you are not permitted to do are being substituted with signage that is more positive. For example, “No Parking” signs can be replaced with “For Security Purposes, Emergency Vehicles Only.” In order to conform to the MUTCD, standard parking regulatory signs should be used as the primary signs. Explanatory signs aimed primarily at customer service should be considered supplemental as sign installation space permits.

2.3.2.5 Terminal

There is relevant research that can be applied to develop a systematic process for evaluating an airport terminal that will ultimately yield improvements in the passenger wayfinding experience by understanding why passengers get lost. When this process is combined with consistent application of the recommended guidelines for design elements (typography, symbology, arrows, legibility, etc.) the net result can provide continuity within an airport as well as across the aviation industry. When passengers travel from one airport to another, the information they need is presented in a consistent and uniform manner based on the new guidelines.

When reviewing these research studies, one common denominator was the role that airport planning has in wayfinding (e.g., floor plan layout, number of different levels, etc.). One study by Andre states how the vast structure of the passenger terminal creates a complexity that most architects involved in airport planning are not equipped to simplify; that is, they lack a formal, theoretical framework for understanding human spatial cognition and for relating its implications to the design of the terminal or its wayfinding system (e.g., signs, maps, directions)². While this is a strong statement, it does imply the need to address, on some level, the impact the architectural design has on how intuitive a space is versus how complex it can be.

Other examples of literature research yielded interesting information with regards to the role architectural configuration has on wayfinding. O’Neill³ notes that each wayfinding study developed a set of variables thought to influence wayfinding. Of these variables, a number of studies suggest the complexity of floor plan configuration is the primary influence on wayfinding performance. It was also noted that signing is commonly employed in an attempt to compensate for the complex floor plan layouts in environments such as subways, hospitals, and airports, and these are the environments in which wayfinding is a chronic problem.

As expected, the results show that an increase in plan complexity is related to a decrease in wayfinding performance. Despite the use of signs, the plan configuration was found to exert a significant influence on wayfinding performance because participants with access to signing in the most complex settings still made more wrong turns than those in the simplest settings with no signs. Apparently, the presence of signs is not able to compensate for wayfinding problems due to the complexity of the floor plan. However, this is exactly what wayfinding in a complex airport environment is expected to do!

2.3.3 Logic

Section 2.3.2 focused on wayfinding strategy step two, the wayfinding philosophy. This section will focus on step three, wayfinding logic. The successful development of wayfinding logic

in step three is contingent on having established a clear wayfinding philosophy on which to build. For example, without placing a priority on an airport's wayfinding to establish distinct information zones, the visual clutter and distractions from advertising and retail will undermine the benefits of applying the wayfinding logic.

2.3.3.1 *Factors That Impact Wayfinding Logic—Wayfinding in Threes*

In separate and unrelated research studies, there was a common wayfinding denominator of three used to describe and/or forecast wayfinding problems. Each study represents a different viewpoint on wayfinding, and taking time to understand these different viewpoints can provide an airport with a broader knowledge base.

Sylvia Harris, Information Design Strategist based in New York City, believes the most navigable spaces have at least three tools:

- Maps for people with good targeting skills,
- Landmarks for those with strong memorization skills, and
- Live personal support for those who prefer verbal instructions.

The goal is to create a supportive space that presents the user with a wide range of wayfinding tools. Creating a supportive environment begins by embracing redundancy.

Researcher Andre agrees that a total wayfinding system is comprised of many elements, but a person's wayfinding ability is most impacted by the physical environment. In order to forecast wayfinding problems, the physical variables need to be identified. These include:

- The degree of differentiation,
- The degree of visual access, and
- The complexity of the spatial layout.

The perceived level of customer service and satisfaction is influenced by the extent to which passengers can easily find their way through the terminal building. According to researcher Fewings⁴, this leads to the human factor aspect; do all air travelers wayfind in the same way? And what techniques are actually used by people to find their way?

Where the route selection involves searching for—or being given information on—new routes, it is termed a dynamic choice problem. This is the type of problem faced by first-time travelers on entering an airport terminal. There is a difference between how individuals wayfind depending on their reasons for needing to reach a destination. From a passenger perception point of view, the journey is just as important as the destination. The three techniques that have been identified are recreational, resolute and emergency wayfinding. They are described as the following:

- **Recreational** wayfinding offers an individual the opportunity to solve problems (where to go next, for example) that can be a source of satisfaction and enjoyment. An example is walking or driving for pleasure, where the traveler is not in a hurry to reach a destination, and therefore, the experience of wayfinding takes priority over the functional aspect of getting from point A to point B.
- **Resolute** wayfinding is used where the main purpose is to find one's way in the most efficient manner. The complexity of the environment may have positive or negative aspects depending on the type of wayfinding being undertaken.
- Under **emergency** wayfinding conditions, the only important factor is reaching the destination as quickly and easily as possible. Due to pressures of time, and possible human factor elements such as stress and panic (fire evacuation of a building), wayfinding must be as simple as possible.

A typical passenger wayfinding experience inside an airport is rarely recreational, most often resolute, and on occasion when faced with the prospect of missing a flight, may be considered an

emergency on the part of the passenger. Nevertheless, of Andre's three dynamic choices, resolute wayfinding is the primary driver behind the programming and design of an airport wayfinding system.

Many of these studies also address wayfinding in a linear/sequential manner (i.e., check-in, security, passport control, and departure gate). Fewings' study cites the principle clues used to wayfind can be identified as landmarks, paths, nodes, and edges. The paths and nodes form networks that can be used as a basis to formulate the wayfinding logic.

According to Braaksma and Cook⁵, there are three ways of making corrections to ensure better visibility inside an existing terminal:

- Change the existing sign and wayfinding system (cheaper solution), or
- Physically modify the terminal layout so elements become more visible (expensive solution), or
- Use a combined approach of making changes to the sign system along with physical modifications.

What this and other studies do not address are the non-linear wayfinding scenarios that a passenger can encounter. The identification of non-linear wayfinding scenarios in a multi-level, multiple-building airport requires a more investigative approach as compared to a sequential wayfinding problem that can be solved with a more evaluative method.

What is an example of a hypothetical non-linear wayfinding scenario? A passenger parks on level four in Garage A, checks in on level two at Terminal A, departs from Concourse B, and returns on level one at Terminal E. How do they find their car?

Connecting passengers can also find a similar challenge when faced with walk-versus-ride choices to get from one terminal to another that can result in a non-linear wayfinding scenario. This directory (Figure 2.6) at Boston Logan Airport (BOS) is a good example of communicating the challenges associated with making successful choices to make a flight connection at this airport.



Figure 2.6. A directory at BOS helps passengers navigate non-linear wayfinding challenges by understanding walk vs. ride options.

2.3.3.2 Identify the Wayfinding Logic

Each airport environment is different and the wayfinding logic used at one airport may not necessarily work at another airport. Step one was gaining buy-in. Step two was adopting a wayfinding philosophy. Step three towards developing an airport wayfinding strategy is identifying the wayfinding logic.

Taking time to develop the wayfinding logic behind a given airport will provide the key that helps unlock the “why” behind the wayfinding solutions. Another way to think of the logic is analyzing the user circulation patterns, both vehicular and pedestrian.

In David Gibson's book, *The Wayfinding Handbook: Information Design for Public Places*, he identifies the following four main types of wayfinding logic based on connectors, districts, landmarks and streets that can all be used to help the passenger understand and navigate an airport environment easier:

- **Connector model**—In concept, this wayfinding strategy follows a loop that leads passengers to different destinations (Figure 2.7). The connector is a simple bold pathway that connects all the destinations. Examples include an airport roadway system that connects multiple terminal buildings, like at John F. Kennedy International (JFK), or an airport Advanced Parking Management (APM) system that connects passengers to multiple terminals, like at Dallas/Ft. Worth International (DFW).
- **Districts model**—In concept, this wayfinding strategy is applicable when an airport is divided into separate districts that create meaningful zones (Figure 2.8). It is applicable to airports with multiple terminals and or multiple parking options.
- **Landmarks model**—In concept, this wayfinding strategy can use architectural features or artwork as landmarks to direct passengers to major destination points. Landmarks help passengers navigate the way to go because they respond to focal points (Figure 2.9).
- **Streets model**—In this concept, easily recognizable corridors or pathways illustrate the wayfinding metaphor of streets (Figure 2.10).

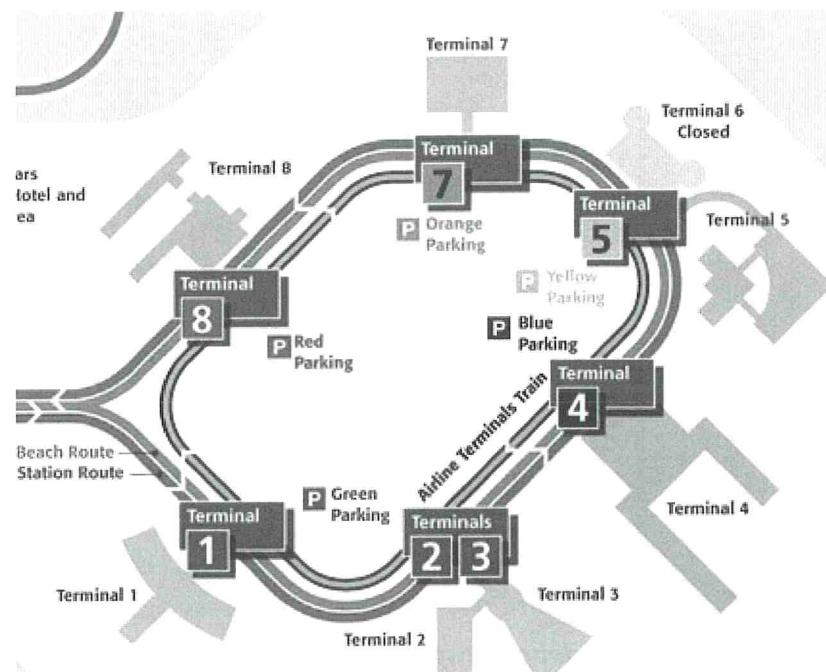


Figure 2.7. An example of the connector model at JFK.

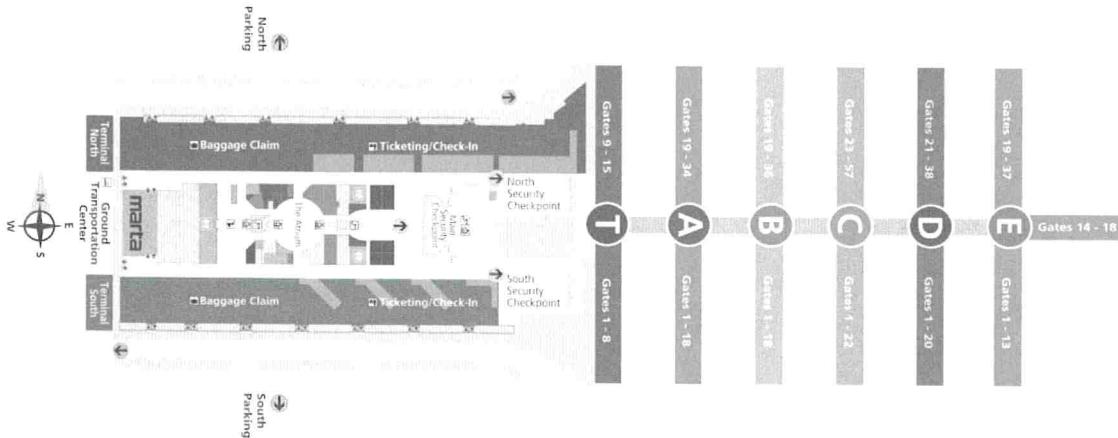


Figure 2.8. An example of the districts model at Atlanta where the concourses are divided into separate zones.

What is the benefit of identifying the wayfinding logic within an airport? The mental process involved will help an airport better understand how to identify the key touch points along the circulation routes as passengers transition through the different stages of airport wayfinding: roadway, parking, curbside, and terminal.

2.3.3.3 Continuity

Another key concept that applies to virtually any airport wayfinding logic is continuity. There are two ways to apply the continuity concept. The first method applies mostly to linear wayfinding scenarios. Start by thinking of each decision point as a link in a **wayfinding chain**. In order



Source: Jon Yee.

Figure 2.9. Munich Airport: the BMW Sheer Driving Pleasure sculpture weaving across the terminal serves as a constant landmark from both the ticketing and mezzanine levels.

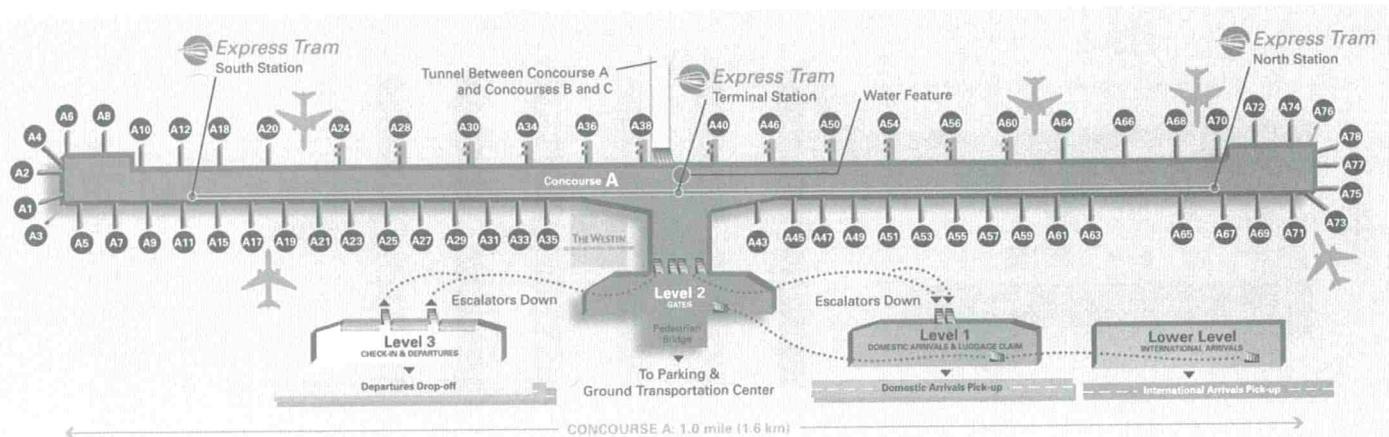


Figure 2.10. Concourse A at Detroit Metropolitan Airport's (DTW) McNamara Terminal serves as an example of a streets model, with road-like pathways.

for a chain to serve its intended purpose, each link must be connected. The wayfinding chain is no different. Whether driving or walking, if a person reaches a decision point and the message they are following is missing, the wayfinding chain is broken and they become lost as a result. For motorists this can quickly become a safety issue when they begin making wrong turns or weaving across lanes. One of the wayfinding evaluation methods is to test the wayfinding chain for airport destinations by physically driving and walking through the entire wayfinding journey for each destination.

The second method is related to non-linear wayfinding scenarios that are more analogous to a **spider web**, where every strand of the web is connected. It is practically impossible to touch any strand in the web without the rest of the web moving. If the overall airport wayfinding system is a wayfinding web, many airports fall into the trap of making changes to one part of the web without realizing how those changes tie into the rest of the wayfinding system. This lack of understanding can result in gaps in continuity as changes are inevitably made to the airport wayfinding system. Therefore, when maintaining an airport wayfinding system it is vital to the integrity of the wayfinding to thoroughly evaluate the ripple effect of any changes to the airport's wayfinding web in order to avoid creating any gaps.

The ripple effect can be far-reaching and can become quite challenging when applied to non-linear wayfinding scenarios. However, some of the challenges can be simplified by matching up points of origin with destination points. In other words, start by asking where people are coming from and where are they going, which leads into connectivity.

The previous section looked at factors that impact the wayfinding logic. Now it is important to look at the factors that affect planning the route. Linear wayfinding scenarios tend to focus on one route that is dictated by the roadway or architecture with multiple decision points along the route. On the other hand, non-linear wayfinding scenarios may have several different routes to choose from.

How do you determine which is the best route? By evaluating each possible route with the following three factors:

- Safety
- Length
- Simplicity

Safety. Priority number one is always safety, so are there situations where the safest route is not the best overall route? Absolutely. There may be other routes that are equally as safe but can offer a simpler or shorter path without sacrificing safety.



Figure 2.11. A dedicated pedestrian pathway in a parking garage at DFW airport.

Length. It is easy to believe the shortest distance between two points is always the best route, but not necessarily when it comes to wayfinding. The shortest route may place pedestrians in conflict with vehicular traffic and therefore create a major safety hazard. Just because a route is the shortest does not mean it's the safest, especially in environments shared by vehicles and pedestrians, such as parking garages (Figure 2.11).

Both pedestrians and vehicles share the same parking and curbside areas. The preferred path of travel must factor in safety.

Simplicity. In complex wayfinding environments like an airport, it is important to keep the wayfinding as simple as possible. However, simple is not always best. For instance, if time is the most critical factor for a passenger making a connecting flight and they are faced with a choice to walk vs. ride, the simplest route may not be the quickest and a passenger risks missing their flight.

By incorporating these three factors as part of the process for developing the wayfinding logic, the best overall route for any given airport can be identified.

2.3.3.4 Connectivity

The simplest way to explain connectivity is origin and destination—where people are coming from and where they are going. Different types of passengers can have different means of access to the same destination. For instance, the seemingly simple task of guiding a passenger to the airport terminal can vary greatly. Figure 2.12 illustrates how each of these different origination points need to all connect the wayfinding system.

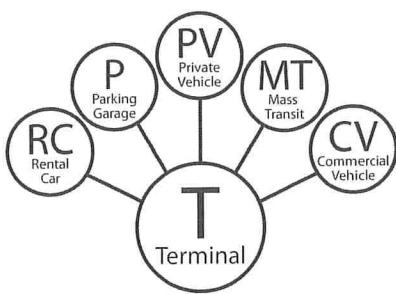


Figure 2.12. Each origination point within the airport must connect the wayfinding system.

Multi-level buildings can create complex passenger movements: some paths are unique, other paths will overlap. Each path must be mapped and decisions points identified in a consistent and efficient manner for each type of passenger movement. Passenger types to consider include:

- Departing passengers
- Arriving passengers—terminating
- Arriving passengers—connecting

Whether tracking linear or non-linear wayfinding routes, using exploded axonometric views (Figure 2.13) can help map the flow of different types of passengers.

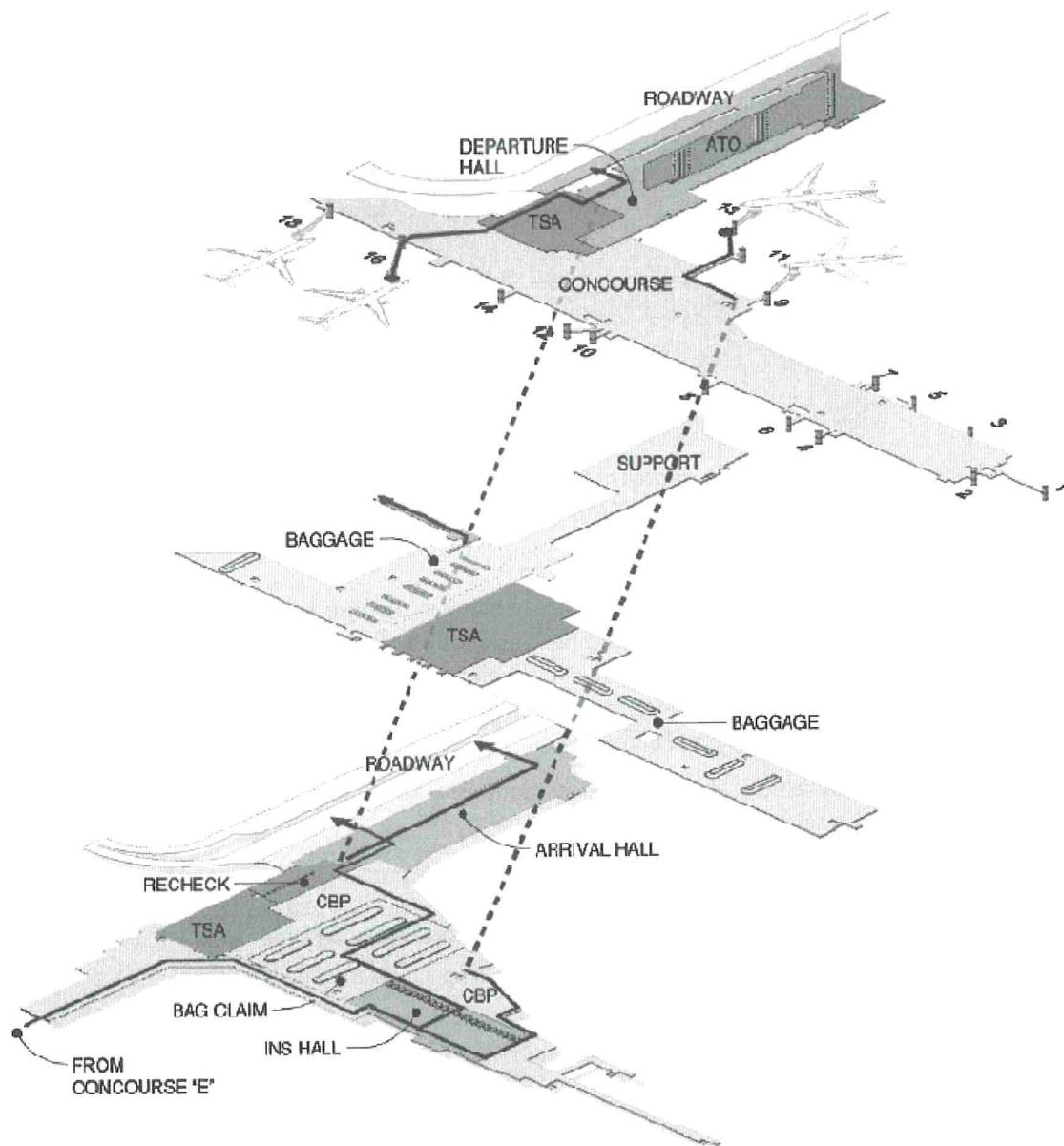
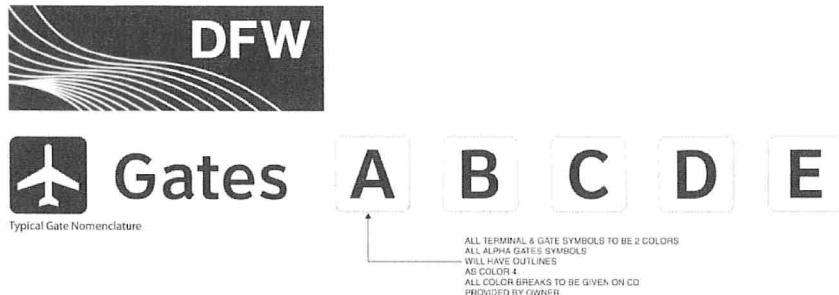


Figure 2.13. Exploded axonometric flow diagram for arriving passengers. The dashed red and blue lines represent non-linear passenger circulation paths in a complex multi-level terminal.

2.3.3.5 Follow Through with Consistency

The above wayfinding chain and spider web analogies are two ways to illustrate the continuity concept, but the underlying principle is consistency. If there is one word to describe the backbone of an airport wayfinding system it is consistency. From the moment a driver enters the airport until they board their plane, information must be presented in a consistent manner (Figure 2.14).



These photographs illustrate consistent use of the Terminal Identifier from Roadway to Terminal.



Figure 2.14. These photos from DFW show how the alpha terminal identifier destinations are consistently presented in easy to understand symbol icons.

When evaluating either existing or proposed wayfinding solutions, step one is to determine if it is consistent with the airport's wayfinding strategy and consistent with proven wayfinding design principles.

For vehicular wayfinding, the consistent application of the positive guidance approach is used to increase the likelihood of drivers responding to situations and information quickly and correctly. See Figure 2.15 for examples of inconsistent application of terminal identifiers.

Consistency becomes visible to passengers through the following design elements:

- Terminology and message hierarchy,
- Visibility and legibility,
- Typography and symbology, and
- Format and color.

Consistent presentation of information extends to other forms of communication like maps, directories, and websites. Communication itself must be consistent in both verbal and written form so the public does not become confused by the use of different terms for the same thing.

The backbone of consistency ties directly back to the primary objective which is to achieve uniform application of the guidelines within each airport and from one airport to another.

2.3.3.6 *Celebratory*

Last but not least, look for creative ways to celebrate the remarkable experience of air travel. Decorative graphics on feature walls, thematic design treatment of the sign system, artwork, and landmarks can all be used as means to celebrate with emotion (Figures 2.16 through 2.19).

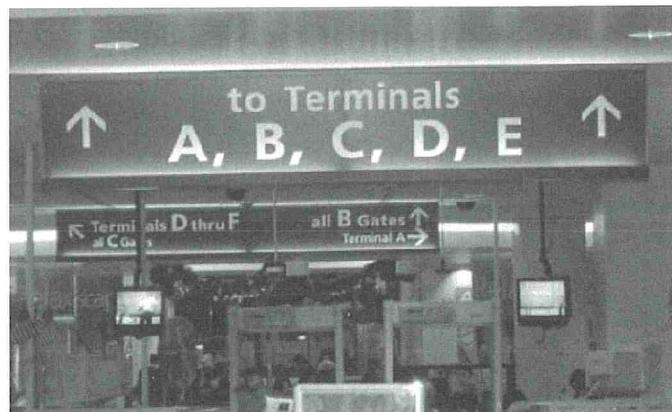


Figure 2.15. Examples of inconsistent application of terminal identifiers within the same airport. In the second sign the bottom photo also illustrates inconsistent terminology use between terminals or gates.

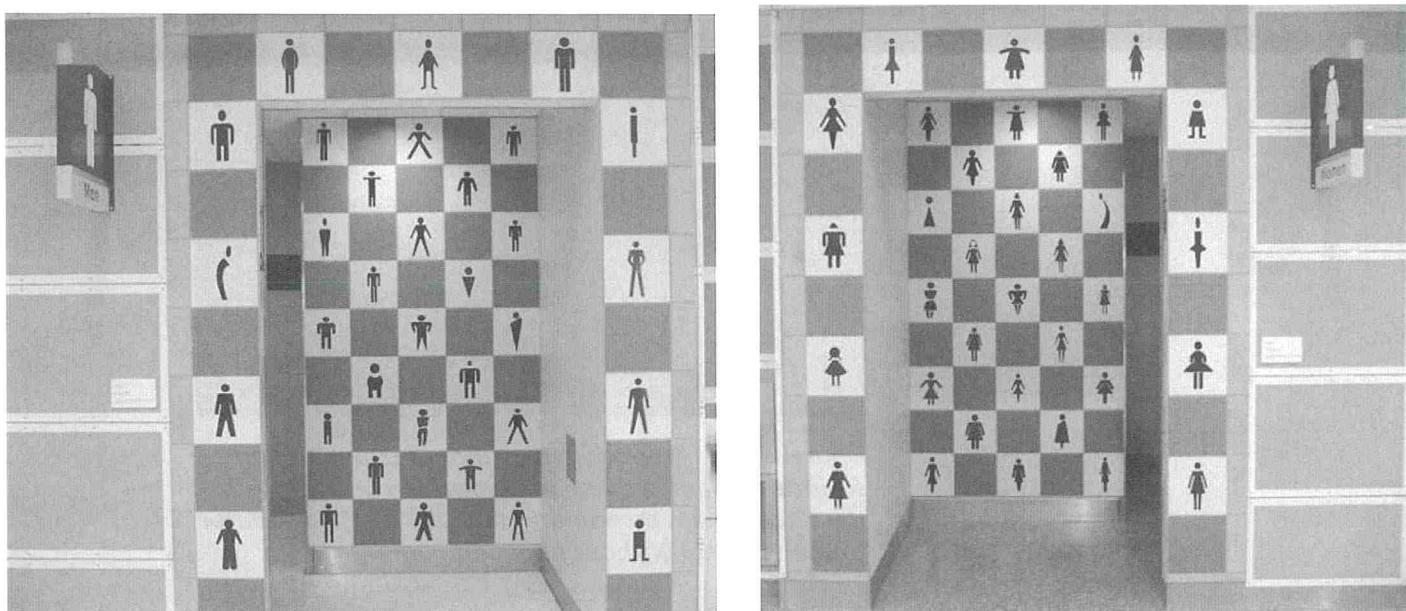


Figure 2.16. Entrance to the Men's and Women's restrooms at the Jacksonville Airport (JAX).

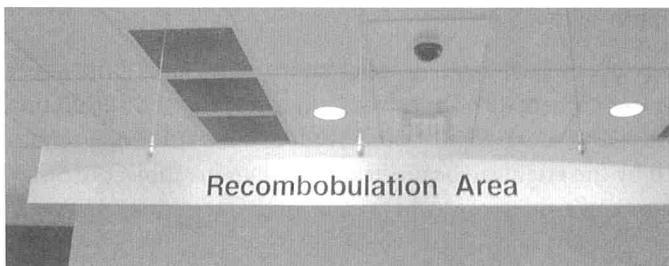


Figure 2.17. The security screening experience can be somewhat "discombobulating," so it only makes sense to provide passengers with a "Recombobulation Area."

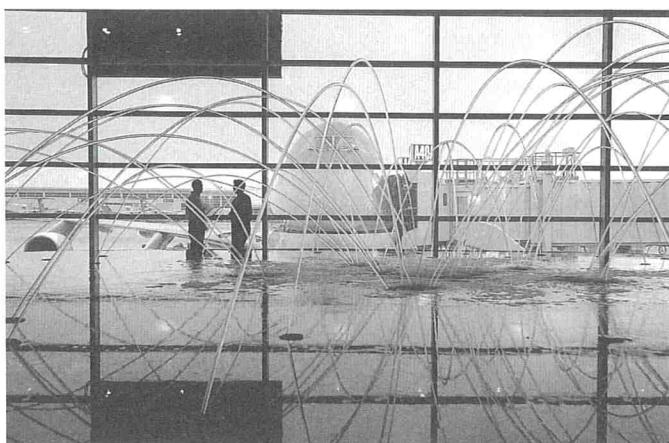


Figure 2.18. Sensory perception is another way to evoke emotion in a memorable way. The sight and sound of the animated water feature is a great example at DTW's McNamara Terminal (photo courtesy of Vito Palmisano).

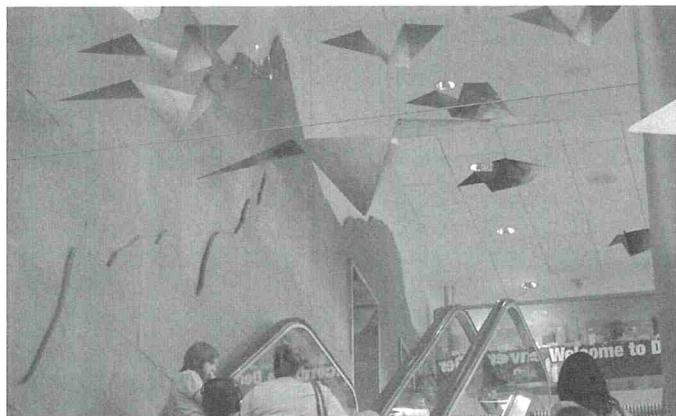


Figure 2.19. Artwork in the form of paper airplane sculptures leads arriving passengers in Denver from the airport train by pointing the way up the escalator to the terminal without depending on signs.

Humor is a great emotion that can also be a means to celebrate as well as reduce anxiety associated with air travel, whether it is simply the time factor associated with the fear of missing a flight, or the actual fear of flying itself.

When used in a roadway environment, celebratory signs should not distract the driver, nor obstruct views of traffic control devices. Advertising is not allowed within public highway rights of way in accordance with Federal regulations. Outdoor advertising adjacent to the highway right of way is controlled by the Highway Beautification Act and is subject to State outdoor advertising control programs and regulations, which each State is required to have.

Roadways

3.1 Wayfinding Philosophy and Principles

For specialized destinations like airports, drivers must make multiple decisions in a relatively short span of time and distance. Although airport roadways may have grades, curves, and lane configurations similar to those of a highway, maximum posted speeds on airport roads are typically much lower. Simple and consistent signing throughout an airport's roadway network is essential to good wayfinding and safe driving.

When designing airport wayfinding and signage, the designer and airports are directed to reference the FHWA's most recent MUTCD for certain engineering design guidelines. Information regarding letter heights, panel sizes, vehicle speed, line-of-sight readability, highway shields, and symbols is to be referenced and considered. It should be noted, however, that many airports across North America have roadway wayfinding signage systems that currently exist in varying degrees of non-compliance with the MUTCD's guidelines regarding roadway sign colors, shapes, and fonts. These airports utilize roadway signs that incorporate fonts, colors, symbols, and shapes reflective of that airport's signage system that provide a consistent graphic message throughout the entire airport journey from roadway to curbside to terminal.

From a historical perspective earlier versions of the MUTCD were not explicit that the provisions of the Manual applied to airports and other private roads, though this expectation was implicit in earlier language concerning authority to install traffic control devices. In a 2004 interpretation, subsequently incorporated into the 2009 MUTCD, airport roadways are clearly included as "private roads open to public travel" and thus are subject to the MUTCD provisions. Due to the ambiguity in the past concerning the need to comply with the MUTCD and the difficulty in designing systems that comply fully with the Manual's standards and guidance, many existing airport signing systems do not conform with the Manual.

The challenge for both airport management and the roadway sign design professional is to find a common ground that can satisfy both viewpoints under the current MUTCD guidelines. These differing viewpoints may be summarized as follows:

Airport Management Viewpoint Regarding Roadway Signs:

- Airport signs are an identity or branding of the airport (i.e., use of similar color and style of signs throughout), providing a sense of arrival and the beginning of the airport user's experience.
- Airport signs should look different than freeway signs, as a means to slow down traffic and confirm entry into a different environment and essentially to say "pay attention—you have arrived at the airport."

Roadway Sign Design Professional Viewpoint:

- Airport signs should comply with all traffic signage regulations and design criteria, including the Manual on Uniform Traffic Control Devices (MUTCD).
- The more an airport road can be made to look and function like a regular road, the more it will conform to driver expectations which will lead to a safer and less frustrating driving experience.

The basic criteria for an effective wayfinding system include the thorough programming of all aspects of vehicular and pedestrian traffic flow, and the appropriate delivery of all pertinent information to the traveler, visitor, or employee. Given the dichotomy between real world application and the MUTCD guidelines, and the fact that the MUTCD does not currently have a section to address the specific needs of airports, this chapter identifies methods and strategies for developing a roadway wayfinding system that is compliant with the MUTCD. This chapter also addresses the meaning of the terms “engineering judgment” and “request for experimentation” and their relevance for airport roadway design (see Section 3.2.2—Airport Roadways and the MUTCD).

Important Note: The MUTCD contains very specific terminology and direction for its proper use. Designers who use the MUTCD are required to understand and apply that direction appropriately. Since this ACRP document is not the MUTCD and only references non-specific content and use, it is not necessary to use the same strict level of terminology and language that exists in the MUTCD itself. For any reference to the MUTCD contained within this ACRP document, the various terms used (i.e., standards, guidance, guidelines, options, requirements, and recommendations) are not intended to be strictly interpreted as if they are used in the MUTCD. As stated previously, the designer should understand and apply the full meaning and intent of all specific terms of use when applying the MUTCD in the sign design process.

3.1.1 Considering User Requirements and Limitations (Human Factors)

Drivers entering an airport roadway system bring with them all of their experience and expectations about roadway design and traffic control. This experience is gained by driving on conventional roads and highways. The more an airport road can be made to look and function like a regular road, the more it will conform to driver expectations which will lead to a safer and less frustrating driving experience.

That said, many legacy airport complexes have been planned and developed in a manner that has resulted in unusual and unorthodox roadway layout and designs when compared to typical roadway systems. As a group, in general, airport roadway users often have unique characteristics due to their unfamiliarity with the roadway system and integrated facilities, coupled with potentially high levels of driver stress caused by tight flight schedules, security warnings, and other factors. Finally, because airport roadway systems transition downward in speed as they terminate in high-density parking terminal environments, this creates difficult combinations of vehicular and pedestrian signing. All of these factors require airport roadway sign designers to utilize all of their skills to plan and design the most safe and efficient guidance and information signing system for both vehicles and pedestrians.

It is important to remember that roadway signs for vehicular drivers should be considered fundamentally different than interior and, to some degree, even parking facility signs. The users of roadway signs are in vehicles moving at much higher speeds, and their attention should primarily be directed toward the safe operation of their vehicle, including their interaction with pedestrians, such as in terminal curbside areas. Drivers will more easily and safely navigate when they can rely on their previous experience with roadway signs. By making airport roadway signs look, feel and operate like other roadway signs, the needs of the driver are better served. The principle of **uniformity** as promoted in the MUTCD does not end at the airport property line.

As previously noted, the MUTCD does not have a separate chapter or section on airports. Nevertheless, until that time when such a section exists, the principles of the MUTCD can and should be applied to airport roadway signing using sound engineering judgment. Section 1A.02 of the MUTCD lays out key principles of all traffic control devices, which include signs, marking, signals, and related devices. This section provides guidance that states:

To be effective, a traffic control device should meet five basic requirements:

- A. Fulfill a need;
- B. Command attention;
- C. Convey a clear, simple meaning;
- D. Command respect from road users, and;
- E. Give adequate time for proper response.

This section further lists five aspects that should be considered in order to ensure that a traffic control device meets these requirements:

1. Design
2. Placement
3. Operation (for signals and changeable message signs)
4. Maintenance
5. Uniformity

One of the main challenges facing an engineer when designing traffic control device layouts for roadways at legacy airports is how many decision points should there be and how close should they be spaced combined with unusual roadway geometrics. It is important to remember that traffic control devices (including signs) are not necessarily the best remedy for all traffic operations needs. Signing and pavement markings cannot correct fundamentally poor or unusual roadway, intersection, and ramp design. Good communication with drivers begins with good roadway design that conforms to their expectations. Traffic engineers may need to conduct an engineering study of roadway, intersection, and ramp design to discover if changes to the geometric design of the road to better conform to driver expectations offer a better solution than a traffic control device. In many legacy airport situations the geometric design may not be able to be altered. The MUTCD acknowledges this close connection between roadway design and traffic control devices in Section 1A.09, which states:

Early in the processes of location and design of roads and streets, engineers should coordinate such location and design with the design and placement of the traffic control devices to be used with such roads and streets.

Traffic safety engineering often talks of the design driver—a hypothetical person for whom the roadway is tailored. In order to provide a margin of safety, the design driver is typically assumed to be unfamiliar with the area and driving under less than ideal conditions—such as at night or in the rain. In an airport situation, this design driver could also be assumed to be pressed for time and mentally distracted due to travel concerns and unfamiliar surroundings. All of these factors lead to designs which assume the driver needs longer than average response and reading times to process signs and roadway elements. It is often hard for designers to put themselves in the role of the unfamiliar driver, but it is essential for good signing decisions.

Section 1A.02 of the MUTCD also stresses that “vehicle speed must be carefully considered as an element that governs the design, operation, placement, and location of various traffic control devices.” Drivers need time to process the information present on road signs, building signs, and curbside signs. If the roadway design does not provide adequate distance, a speed reduction on the roadway is one way to provide drivers more time to process the information. Any changes to posted speed limits should be accompanied by adequate roadway and roadside design along with speed enforcement to accomplish the desired behavioral change.

Close placement of signs, excessive sign messaging and subsequent information overload, is a concern at airports due to the closely spaced access points to many destinations such as multiple terminals, multiple parking facilities, rental car facilities, curbside loading/unloading and various other airport services. The need to provide signs for each of these areas leads to shorter sign spacing and more sign information than is generally recommended in most roadway sign standards and guidance documents. It is important to remember that people react in time but standards are written in distance. The standards for sign spacing and letter height are included in this section. If adequate distance can't be provided due to site and roadway characteristics, then roadway speeds should be lowered if possible to provide adequate time for drivers to respond, or letter heights should be larger, or both. It should be noted that reducing driver speed, especially at the entrance to the airport where they may be transitioning from a typical freeway or arterial environment, requires road design changes to support the requested reduction in speed. A change in the posted speed alone is typically ineffective. Altering roadway and roadside design, along with speed management techniques and law enforcement of posted speeds, may also be crucial for compliance.

Drivers' visual and cognitive abilities vary greatly and these affect how easily a sign can be read and understood. Vehicle and headlamp design also affect sign visibility, as does the curvature of the roadway and any horizontal or vertical elements within or adjacent to the roadway. The legibility standards established in the MUTCD are based on extensive research into all of these areas.

To summarize, design professionals and airports should always start with the MUTCD and its principles when designing and applying traffic control devices in the airport environment. Only after those principles and guidance have been exhausted should they consider an alternate traffic control device design or placement. The MUTCD should always be the point from where airport sign designers begin their design, and any deviations should be noted and justified in writing during the design process.

The guidelines developed for this section are primarily based on the MUTCD and other research and standards for general roadway signing. Readers should always consult the original source documents for the details of implementation.

3.1.2 Positive Guidance

In order for users to have a comfortable and efficient wayfinding experience through an airport roadway system, they need positive guidance. In other words, guide drivers by clearly laying out the proper path.

Although the concept of positive guidance was developed within the areas of traffic engineering and highway design, its principles apply equally to the curbside, terminal and parking lots. Knowledge of human limitations in information processing, and human reliance on previous experience to compensate for this limitation, led to the positive guidance approach to highway design. This approach is based on a combination of human factors and traffic engineering, which was developed in the early 1970s by Alexander and Lunenfeld and elaborated on in a series of documents published by the U.S. Department of Transportation Federal Highway Administration⁶.

The central tenet of the positive guidance approach is that design according to driver limitations and expectations increases the likelihood of drivers responding to situations and information correctly and quickly. Conversely, when drivers are not provided with information in a timely fashion or are overloaded with information, or are surprised because their expectations are violated, slowed responses and errors occur.

With respect to road design, the positive guidance approach emphasizes:

- **Expectation**—Design roadway configurations and geometrics and traffic operations in accordance with driver expectations. Design should conform to long-term expectancies (e.g., there are no traffic signals on freeways, freeway exits are on the right) as well as short-term expectancies (e.g., all curves on this road are gradual).

With respect to traffic control devices, the positive guidance approach emphasizes the following:

- **Primacy**—Determine the placement of signs according to the importance of their information (e.g., stop signs are more important than parking payment signs, or in an airport environment, terminals are more important than cargo areas), and in such a way as to avoid presenting the driver with information when and where it is not essential.
- **Spreading**—Where all the information required by the driver cannot be placed on one sign or on a number of signs at one location, spread it out along the road so that information is given in small chunks, thereby reducing the information load on the driver.
- **Coding**—Where possible, organize pieces of information into larger units. Color and shape coding of traffic signs accomplish this by representing specific information about the message based on the color of the sign background and the shape of the sign panel (e.g., warning signs are yellow and typically diamond shaped).
- **Repetition**—Say the same thing in more than one way (e.g., shape, color). The same information may also be given with two different devices (e.g., “no passing” indicated with a sign and pavement markings), or by two identical devices (e.g., STOP signs on both sides of a wide intersection).

3.2 Applicable Federal Standards

The Federal Highway Administration (FHWA) oversees the standards and practices for traffic signs, signals, and markings. They produce the MUTCD under 23 Code of Federal Regulations (CFR), Part 655, Subpart F. The MUTCD defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic.

The MUTCD approved by the Federal Highway Administration is the national standard for all traffic control devices installed on any street, highway, or bicycle trail open to public travel. For the purpose of MUTCD applicability, open to public travel includes toll roads and roads within shopping centers, airports, sports arenas, and other similar business and/or recreation facilities that are privately owned but where the public is allowed to travel without access restrictions⁵⁴. Each state must adopt the Federal MUTCD or a state-specific alternative manual or supplemental material that is in substantial conformance to the National manual. The recommendations in this document refer to the 2009 Edition of the MUTCD.

3.2.1 MUTCD Organization and Terms

Before addressing MUTCD applicability in airport roadway systems, it is important to understand how the MUTCD is organized and terminology used.

For many sign applications, the MUTCD distinguishes between “Freeways and Expressways” and “Conventional Roads.” The main thing that distinguishes these two road classes from each other is operating speed and the presence of driveways and intersections. For most situations, airport roads (including terminal curbside roads) would be considered “Conventional Roads” because they typically have operating speeds lower than 45 mph, and they have frequent drive-

ways and at-grade intersections and may have pedestrian activity along and/or across them. Airports may also own and operate freeway or expressway-type roadways with limited or partially controlled access and operating speeds higher than 45mph. In those cases, the sign designer should consider use of the principles and guidance in the “Freeways and Expressways” section of the Manual to address the likely higher speeds, volumes and entrance/exit ramp conditions.

The MUTCD refers to signs by their function or class, such as regulatory, warning and guide signs. Each sign class is addressed in a separate chapter of the Manual. In addition, there are additional chapters dedicated to school areas, highway-rail crossings, bicycle facilities, and light-rail transit grade crossings which are less likely to be used by airports.

Throughout the MUTCD, the headings Standard, Guidance, Option, and Support are used to classify the nature of the text that follows. Designers should understand and pay close attention to these definitions and requirements as listed in the MUTCD and defined as the following:

- **Standard**—a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. Standard statements are sometimes modified by options. Standard statements shall not be modified or compromised based on engineering judgment or engineering study.
- **Guidance**—a statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. Guidance statements are sometimes modified by options.
- **Option**—a statement of practice that is a permissive condition.
- **Support**—an informational statement which provides background and rationale for a standard, guidance, or option statement.

3.2.2 Airport Roadways and the MUTCD

The MUTCD contains little guidance on how to apply MUTCD principles and standards to airport roadways as a unique category although it does specifically state that airport roads open to public travel shall comply with the MUTCD. This lack of detailed guidance does not, however, give airport sign designers and operators permission to avoid compliance with these roadway signing standards. Airports should retain the services of licensed professional engineers who are experienced in roadway design, including roadway signing design, and are therefore able to exercise engineering judgment for particular site and traffic flow characteristics.

In Section 1A.09 of the MUTCD, the Manual addresses the issue of engineering judgment by stating as a Standard Statement, “This Manual describes the application of traffic control devices, but shall not be a legal requirement for their installation.” It provides further guidance which states that engineering judgment should be exercised in the selection and application of traffic control devices. Engineering judgment does not mean, in this context, that substitution of alternative devices can take place at will. The formal request for experimentation process, including the evaluation, described herein should be followed.

The MUTCD does allow some flexibility in interpretation through engineering judgment and study. It is important to note, however, that the Manual clearly states any Standard statement cannot be ignored or overruled by engineering judgment. Only Guidance and Option statements can be interpreted through engineering judgment (see Section 1A.13, definition of a Standard; also reference Official Ruling No. 1(09)-1(I) issued October 1, 2010).

FHWA has made provision for agencies to request interpretations of MUTCD language to particular situations. An agency can also request experimentation with a new traffic control device or application of an existing device to a new situation. Experimentations require a formal evaluation of the device to demonstrate that the new device provides an improvement over the current stan-

dard. The process for these types of requests is detailed in Section 1A.10 of the MUTCD. A library of past interpretations and current experimentations is maintained by FHWA at their website^{7,8}.

A listing of additional related resources is available in Appendix E.

3.3 Airport Roadway Decision Points

Airport roadways present a unique challenge for motorists, especially for infrequent travelers or those making their first trip to the airport. Motorists are faced with several decision points in close proximity to one another as they transition from adjacent freeways to the airport. These decision points may include the following:

- Exit ramp from freeway,
- Airline name/terminal listing,
- Split between roads leading to each terminal,
- Split between arrivals and departures,
- Split between curbside, parking and car rental,
- Split between short term and long term parking, and
- Return to terminal or exit airport property.

In order for a driver to navigate to the intended destination safely, signs need to be conspicuous, legible, brief, understandable, and located a sufficient distance from the choice point (and each other) to allow enough time to detect, read, make a decision, and make the necessary lane changes.

An airport operator should analyze the roadway system in order to identify these decision points. One way to do this is to create a matrix of likely trip purposes as shown in Figure 3.1

Roadway Name	Type of User	User Familiarity	Trip Purpose	Trip Origin	Trip Destination	Information Needs
Wright Blvd.	Departing Passenger (local resident)	Familiar	Park in Garage	Main Entrance	Garage	Which terminal is my airline? What are the parking options? Where is the entrance to parking?
	Departing Passenger (non-resident)	Unfamiliar	Return Rental Car	Main Entrance	Rental Area	Where is the rental return? Where is the entrance to return? Where is my specific car agency?
	Taxi	Familiar	Pick-up	Re-Entry Road	Arrivals Curbside	Detours/Incidents
Service Road	Postal patron	Familiar	Drop off mail	Wright Blvd.	Post Office	Where is the Post Office? How do I get there?
	Employee	Familiar	Work	Wright Blvd.	Employee Parking	Detours/Incidents
Airfield Dr.	Truck driver	Unfamiliar	Food delivery	Main Entrance	Loading Dock	Where is the delivery area? How do I get there? Are there height and weight restrictions?
	Personal Vehicle	Familiar	Pick-up Passenger	Main Entrance	Cell Phone Waiting Area	Is there a waiting area? How do I get there?

Figure 3.1. Example of trip purpose and travel path analysis.

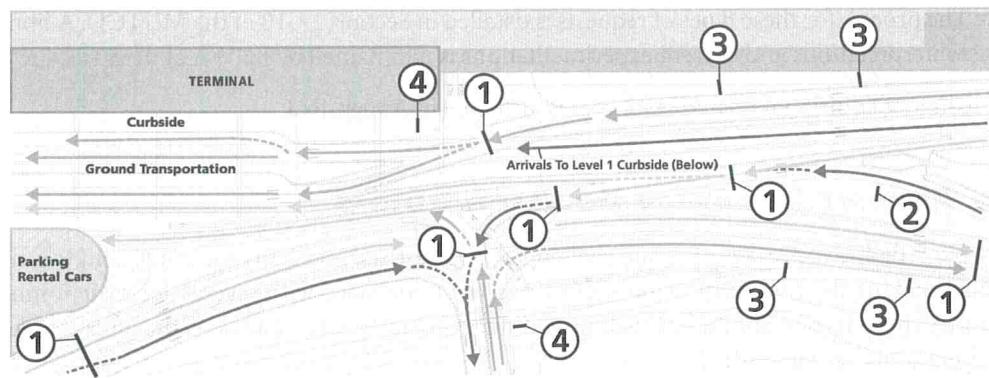


Figure 3.2. Example decision point and circulation flow diagram from the Mineta San Jose International Airport.

(adapted from Hawkins, et al.⁹). Note that one roadway could be serving drivers with differing trip purposes and information needs. This table is for illustrative purposes only; each airport should consider its many users and paths through its facilities.

The Mineta San Jose International Airport is one example of a facility which has conducted a thorough circulation analysis for both motorists and bicyclists¹⁰. Overlaid on this roadway diagram are circles indicating decision point locations at intersections and ramps (Figure 3.2). These circles, then, serve to flag areas where advance directional signing is needed.

3.3.1 Airport Exit Signs

Signs leading drivers out of the airport are as important as those leading drivers in. As drivers exit the airport, decision points include the splits between remaining within the airport and exiting the airport from the terminal to major freeways or destinations (e.g., city downtown). Conformance to the MUTCD is important as these signs begin to prepare drivers to enter state and local roads. The use of standard route markers and sign colors is especially important. Local jargon terms for routes should be avoided in favor of highway numbers that would appear on roadway maps. Key destinations, such as “Downtown” or “TO <Major Highway>,” should be listed on exit signs, particularly in advance of lane splits (see Figure 3.3). On a national level, control



Figure 3.3. MUTCD route numbers used on signs at DFW.

destinations should conform with the AASHTO list of control cities and/or official control destinations as determined by the State DOT for the region (AASHTO Guide Signs, Part III: List of Control Cities for Use in Guide Signs on Interstate Highways)¹¹.

3.4 Static Sign Design Elements

3.4.1 Terminology

The terminology used for airport roadway signing should be straightforward. The roadway signing terminology should be reviewed as part of the overall airport passenger experience, (parking, curbside, and terminal), to ensure all terminology conveys a cohesive and consistent message. A basic premise for guide sign messaging is to use as few words as possible. The reason is reader comprehension that is dependent on rate of travel, viewing distance, and length of message. These factors such as the length of the message (Departures as compared to Ticketing/Check-In) also impact driver safety. The following are key terminology:

- **Terminal**—is required if there is more than one terminal or if the one terminal has a split curbside (e.g., North/South). If there is more than one terminal the messaging will require a unique designation for each terminal. Simple designations such as 1, 2, 3 or A, B, C work best for roadway applications. (See Figure 3.6)
- **Arrivals/Departures**—used to identify the curbside areas for passenger drop-off and passenger pick-up at the terminal.
- **Parking**—used to identify parking at the airport. Most airports have multiple parking products that can include Hourly, Daily, Economy, Cell Phone Lot, and Valet parking. The specific terminology used to differentiate the various parking products should be part of an overall parking strategy. (Reference Section 4.3 for additional information associated with the signing and naming of parking products.)
- **Return to Terminal and Airport Exit**—these terms are typically used to direct traffic after the motorist has passed the terminal and must decide whether they need to go back to the terminal or exit the airport.
- **Airline listings**—Airline information is typically not posted for a single terminal with one common curbside. This information is typically posted at an airport with multiple terminals or a split curbside serving a single terminal.
- **Rental Cars**—Used to identify rental car facilities that include rental car pick-up by area residents and rental car returns, in addition to rental car use by arriving passengers. Within the facility area, separate signage for Rental Car Return and Rental Car Lobby should be provided.
- **Internet Addresses and Phone Numbers**—Some airport operators may wish to place phone numbers or Internet address information on roadway signs directing drivers to call for parking or terminal information. This practice is expressly forbidden by the MUTCD out of safety concerns. The mental effort required to read and remember web addresses is more than for typical traffic sign words. These materials are permitted in an option statement for locations that are low speed “where an area is available for drivers to stop out of the traffic flow to read the message” (MUTCD Section 2A.06, paragraph 16) or for signs designed to be viewed only by pedestrians or occupants of parked vehicles.

3.4.1.1 Lines of Text and Message Hierarchy

The number of lines of text on roadway signs needs to be limited to prevent drivers from taking their eyes off the road for too long. The MUTCD stops short of issuing a standard on the maximum number of lines of text but does offer a Guidance statement in Section 2D.07 that recommends limiting signs to three lines of text.

This is a Guidance statement, which is a recommended practice and is subject to modification by engineering judgment or study. For signs that list airlines and terminal assignment, many airports list more than three airlines on a single guide sign. If this practice is adopted, it is important to:

- List the airlines alphabetically and spread out the list as much as possible to avoid information overload. If necessary, use multiple signs.
- Provide adequate letter size for easy and quick legibility of all names listed before the sign is passed at the operating speed (assume approximately $\frac{1}{2}$ to 1 second reading time per major word or name and legibility of 30 ft per inch of letter height).
- Provide good letter-to-background color contrast for easy reading.
- Provide adequate space (see next section regarding spacing rules) between successive signs to provide mental processing of the information provided.
- Repeat the signs to the extent possible.

A uniform hierarchy of messages and information should also be developed. This permits a consistent sign system that considers location of the message on the sign (which line on the sign), and where the message resides (overhead sign or roadside sign). Messages should be categorized as primary or secondary.

Primary messages include Terminal, Parking, Rental Cars, Airport Exit, Return to Terminal, and major access roads. Primary messages would most likely be placed on an overhead sign. Placement of primary messages takes priority over secondary messages.

Secondary messages include Departures, Arrivals, Terminal designations, airline names for each terminal, and specific parking destinations. Secondary messages supplement or reinforce information already conveyed by the primary messages. Secondary messages may also be on the overhead sign, or considered for placement as a roadside sign.

3.4.2 Symbology

The MUTCD makes a distinction between symbols and pictographs. A symbol can stand alone as a substitute for text on a sign while a pictograph is an illustration that is supplemented by text on a sign.

According to the MUTCD a “symbol” is defined as, “the approved design of a pictorial representation of a specific traffic control message for signs, pavement markings, traffic control signals, or other traffic control devices, as shown in the MUTCD.” Designs of pictorial representations that have not been approved are not appropriately termed “symbols.” Based on the airport surveys, the majority of airports currently use the following pictorial representations on roadway guide signs that are not adopted in the MUTCD:

- Arrivals—plane descending
- Departures—plane ascending
- Parking—“P”
- Rental cars—RC symbol

Terminal identifiers, i.e., A B C or 1 2 3 as noted in Figure 3.6 are approved by the MUTCD and serve as important symbols at airport facilities with multiple terminals and/or parking products.

The 2009 Airport sign survey indicated that 22% of the airports surveyed included parking, arrivals (plane descending), departing (plane ascending) and rental car symbols. Another 30% had other symbols on their roadway signs such as parking “P” alone, terminal identifiers (A B C or 1 2 3), rental car symbol alone, or hotel symbols.

It should be noted that the symbols for Arrivals, Departures, and Rental Cars are not listed as acceptable symbols in the MUTCD since they have not undergone testing for legibility and comprehension. These should be treated as pictographs with accompanying explanatory text.

Rental Car symbols were studied in a 2008 FHWA project which tested three alternatives for rental car symbols and found that none of them performed acceptably in either comprehension or legibility. Another study also found the current rental car symbol (car with a key above it) to be poorly understood, even though the majority of study participants had rented vehicles. No better alternative symbol has yet been found, suggesting that including the text "Rental Cars" may assist drivers.

The MUTCD recommends the use of trailblazer signs on major roads leading to the airport property, featuring the airport symbol. The MUTCD states the following:

- Guide signs for commercial service airports and non-carrier airports may be provided from the nearest Interstate, other freeway, or conventional highway intersection directly to the airport, normally not to exceed 15 miles.
- The Airport (I-5) symbol sign along with a supplemental plaque may be used to indicate the specific name of the airport.
- An Airport symbol sign, with or without a supplemental name plaque or the word AIRPORT, and an arrow may be used as a trailblazer.

In an Interpretation Letter FHWA has authorized users to rotate the symbol so that the airplane is "pointing" at the airport to provide additional cues to drivers, particularly at decision points like intersections. The rotation of the airport symbol does not replace the directional arrow sign installed below the airport symbol sign. In any orientation, the airport symbol should always be accompanied by a standard directional arrow plaque¹².

3.4.3 Typography

The fonts (also referred to as typefaces or lettering styles) allowed for use on roadway signing are limited to those listed in the MUTCD which are the FHWA Standard Alphabets. In 2004, a more recently developed font, Clearview™ Highway, was allowed for optional use.

The most typically used FHWA Standard Alphabet lettering style for guide signs that has an upper and lower case letter set is called E-modified. A related font that has narrower, more condensed letterforms called Series D is used for guide signs on conventional roads. Legibility research has shown that drivers can read high performance retroreflective sheeting signs with the Clearview™ typeface 10–12% further away than FHWA Standard Alphabet E-modified for non-illuminated signs at night. The difference between the two fonts was less for signs made with less bright retroreflective materials, such as engineering grade, and was also less during the day. The Clearview™ font is used by several airports, including Dallas/Fort Worth as shown in Figure 3.3. The use of Clearview™ is the subject of an Interim Approval by FHWA, and its use must be approved by FHWA.

It should be noted that typical airport roadway geometry would not necessarily afford the longer tangent distances in which an increase in nighttime legibility would be realized for non-illuminated signs as a result of using the Clearview™ font.

The MUTCD recommends using the legibility index of 30 feet of legibility for every inch of letter height for static signs. This translates to, for example, a legibility distance of 180 feet for a 6 inch letter. This recommendation is based on several research projects which studied nighttime sign legibility with older drivers. In this regard, it is a conservative number for most roadway situations. Because of the complexity of the airport roadway environment and the density of

information, large letter sizes are encouraged. If smaller letter sizes are used, fewer lines of text should be used and the sign should be repeated whenever possible.

The MUTCD explicitly bans any letter on guide signs smaller than 6 inches, except roads with speed limits less than 25 mph. A letter size of 6 inches applies to the upper case letter, for which the corresponding lower case letter height is 4.5 inches. In general, mixed case (initial letter upper case, subsequent letters lower case) is required over all upper case letters for destinations displayed on roadways signs. Tables 2E-1 through 2E-5 of the MUTCD contain the minimum letter and numeral sizes for roadway static signs by sign type and roadway speed. These tables bring up an important point. Signs should be designed for actual operating speeds that are unlikely to be the posted speed limit. The one inch per 30 foot legibility index corresponds with the 20/40 visual acuity, which is the typical licensing requirement of most motor vehicle agencies without the use of corrective lenses and is conservative for most roadway situations. Letter sizes for changeable message signs are addressed later in this guide.

Typefaces selected for use on interior signing should not be used on roadway signs unless a legibility study of roadway signs has been conducted and a request for experimentation has been filed with FHWA.

3.4.4 Arrows

Directional arrow designs are specified in the MUTCD and accompanying Standard Highway Signs manual which specifies dimensions. Examples of MUTCD standard arrows are shown in Figure 3.4.

The MUTCD does provide for the option of alternative arrows on airport wayfinding signs provided that a legibility study is conducted and a request for experimentation has been filed with FHWA. See Figure 3.5 for examples of arrows evaluated as part of a National Park Service (NPS) legibility study (see also Section 6.5.4 for additional background on the NPS study). The arrow ultimately recommended for use on NPS guide signs, Color Detour 1, performed 18% better than the Federal Highway Administration “Standard Arrow” (M6-3). It should be noted that these arrows have not been approved for use by FHWA. A request for experimentation must be filed along with an evaluation plan if an airport wishes to try these arrow designs.

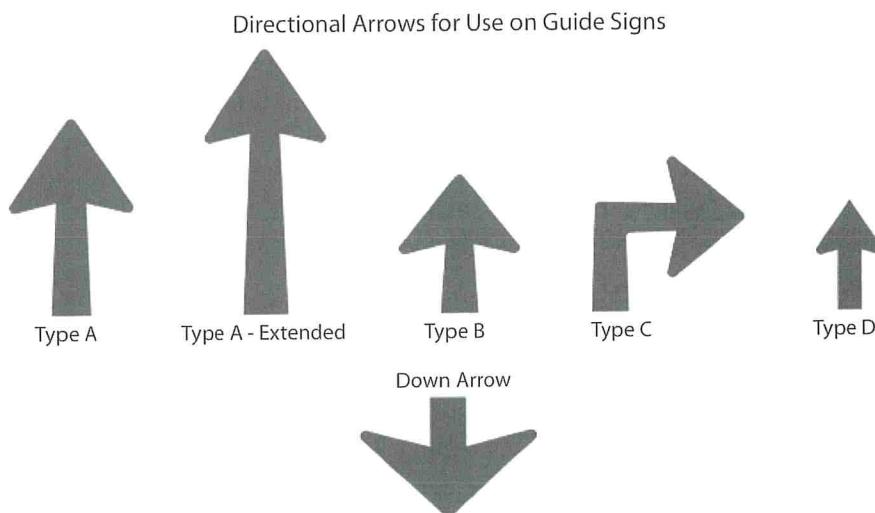
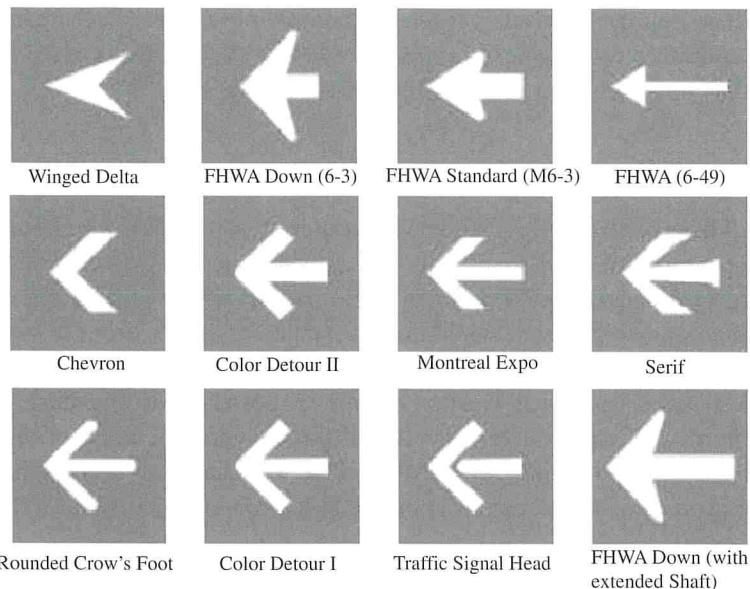


Figure 3.4. Typical arrow shapes from MUTCD figure 2D-2.



Source: National Park Service & Pennsylvania Transportation Institute.

Figure 3.5. Arrow shapes used in the NPS arrow study.

The MUTCD provides guidance for the orientation of arrows on overhead signs in Section 2D. Guidance that particularly pertains to airport roadway wayfinding includes:

- On overhead signs where it is desirable to indicate a lane to be followed:
 - A down arrow shall be positioned approximately over the center of the lane and shall point vertically downward toward the approximate center of that lane.
 - Down arrows shall be used only on overhead guide signs that restrict the use of specific lanes to traffic bound for the destination(s) and/or route(s) indicated by these arrows.
 - Down arrows shall not be used unless an arrow can be located over and pointed to the approximate center of each lane that can be used to reach the destination displayed on the sign.
 - If down arrows are used, having more than one down arrow pointing to the same lane on a single overhead sign (or on multiple signs on the same overhead sign structure) shall not be permitted.
 - Where a roadway is leaving the through lanes, a directional arrow shall point upward at an angle that approximates the alignment of the exit roadway.
- Arrows used on guide signs to indicate the directions toward designated routes or destinations should be pointed at the appropriate angle to clearly convey the direction to be taken. A horizontally oriented directional arrow design should be used at right-angle intersections.

Arrow size should be between 1.5 and 1.75 times the height of the upper-case letters of the principal legend on the sign.

For dedicated traffic lanes that serve one destination or ramp exclusively, also called “lane drops,” special signing is needed. One study found that the addition of a black-on-yellow THIS LANE ONLY plaque at the bottom of the airport guide sign, below the MUTCD standard down-arrow, reduced last minute lane changes. THIS LANE ONLY is not a conventional sign legend. The legend ONLY with a down arrow all in a black-on-yellow panel reduces the units of information and should adequately convey the same message. Supplementary messages such as this, as well as EXIT ONLY, are allowed in the MUTCD and are recommended for lane drop conditions. The preferred installation for lane assignment on overhead signs is the word ONLY with a down arrow all within a black-on-yellow panel at the bottom of an overhead sign. See MUTCD Section 2E.24 for additional guidance.

Exits to the left are counter to drivers' expectations and should be specially marked. This includes parking garage entrances and other exit ramps to the left. MUTCD Section 2E.31 provides guidance on the design and placement of left exit plaques for guide signs.

3.4.5 Color and Shape

The color and shape of a sign helps drivers pick it out from the visual scene. If a driver is actively seeking guidance information, for example, past experience dictates that this will be found on a horizontally rectangular sign, most likely green or blue background. So, in a quick visual scan of a scene, a yellow diamond-shaped sign would likely not register with the driver because he or she is consciously seeking navigational information that is presented in a guide sign format. Consistency in the color and shape of signs on all roadways is important to help drivers quickly read the sign messages. Sign borders of contrasting colors help drivers identify the shape of sign and quickly notice a sign in a cluttered environment. The MUTCD requires the use of borders that are the same color as the legend on all roadway signs. Section 2A.06 contains design details for the borders.

Color coding is often used by airports to aid in wayfinding. Unfortunately, many color coding schemes violate standards specified in the MUTCD. There are provisions for using uniquely colored boxes within a traditional green guide sign as shown in Figure 3.6. The accompanying standard language from the MUTCD explains their use:

- **Support**—Color coding is sometimes used to help road users distinguish between multiple potentially confusing destinations. Examples of valuable uses of color coding include guide signs for roadways approaching or inside an airport property with multiple terminals serving multiple airlines, and wayfinding signs for various traffic generator destinations within a community or area.
- **Standard**—Different color sign backgrounds shall not be used to provide color coding of destinations. The color coding shall be accomplished by the use of different colored square or rectangular panels on the face of the guide signs (see Figure 3.6).

The 2009 MUTCD identifies the 11 colors in current use and the 2 colors reserved for future use:

Both airports and roadways sign design professionals should be aware that the general meaning of the 13 colors shall be as follows:

- Black—regulation.
- Blue—road user services guidance, tourist information, and evacuation route.
- Brown—recreational and cultural interest area guidance.
- Coral—unassigned.
- Fluorescent Pink—incident management.
- Fluorescent Yellow-Green—pedestrian warning, bicycle warning, playground warning, school bus and school warning.

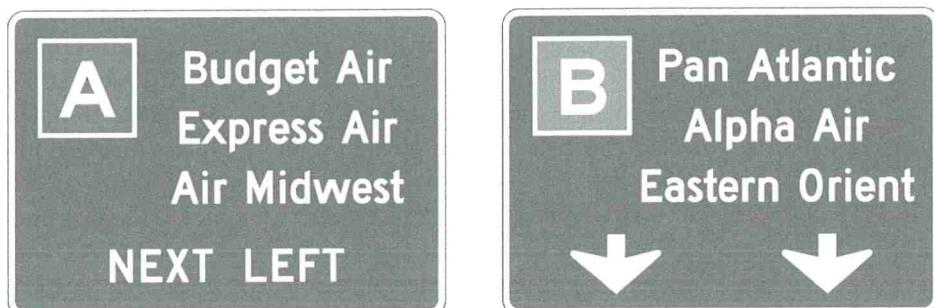


Figure 3.6. Color coding example from the 2009 MUTCD Figure 2D-1.

Shape	Signs
Octagon	* Stop
Equilateral Triangle (1 point down)	* Yield
Circle	* Highway-Rail Grade Crossing (Advance Warning)
Pennant Shape / Isosceles Triangle (longer axis horizontal)	* No Passing
Pentagon (pointed up)	* School Advance Warning Sign * County Route Sign
Crossbuck (two rectangles in an "X" configuration)	* Highway-Rail Grade Crossing
Diamond	Warning Series
Rectangle (including square)	Regulatory Series ** Guide Series Warning Series
Trapezoid	Recreational and Cultural Interest Area Series National Forest Route Sign

* This sign shall be exclusively the shape shown.

** Guide series includes general service, specific service, tourist-oriented directional, general information, recreational and cultural interest area, and emergency management signs.

Figure 3.7. MUTCD's Table 2A-4 "Use of Sign Shapes."

- Green—indicated movements permitted direction guidance.
- Light Blue—unassigned.
- Orange—temporary traffic control.
- Purple—lanes restricted to use only by vehicles with registered electronic toll collection (ETC) accounts.
- Red—stop or prohibition.
- White—regulation.
- Yellow—warning.

The provision to use colored boxes on wayfinding signs allows for the use of the assigned colors in a wayfinding system. This means that terminal or parking color coding used for interior signing can be carried through to roadway signing through the use of these colored panels on standard green guide signs.

As noted at the beginning of this chapter, sign background color is currently a major source of discrepancy. Many airports use colors other than the MUTCD accepted standard green. Based on this standard airports considering alternative background colors should conduct a legibility study and file a request for experimentation with the FHWA.

Shape provides an additional cue to motorists as to the category of sign. The MUTCD provides for the applications of sign shapes in Figure 3.7.

3.4.6 Wayfinding Sign Placement, Spacing, and Design Speeds

Motorists' visual and cognitive abilities vary greatly and these affect how easily a sign can be read and understood. Once a driver reads a sign, he or she must have time to cognitively process the information, decide if a maneuver is required, and execute that maneuver. These steps are illustrated in Figure 3.8.

Section 1A.02 of the MUTCD stresses that "vehicle speed must be carefully considered as an element that governs the design, operation, placement, and location of various traffic control devices." Drivers need time to process the information present on road signs, building signs, and curbside signs. If the roadway design does not provide adequate distance, a speed reduction on the roadway is one way to provide drivers more time to process the information. Any changes to posted speed limits should be accompanied by adequate roadway and roadside design along with speed enforcement to accomplish the desired behavioral change (reference Section 3.1.1 for additional detail).

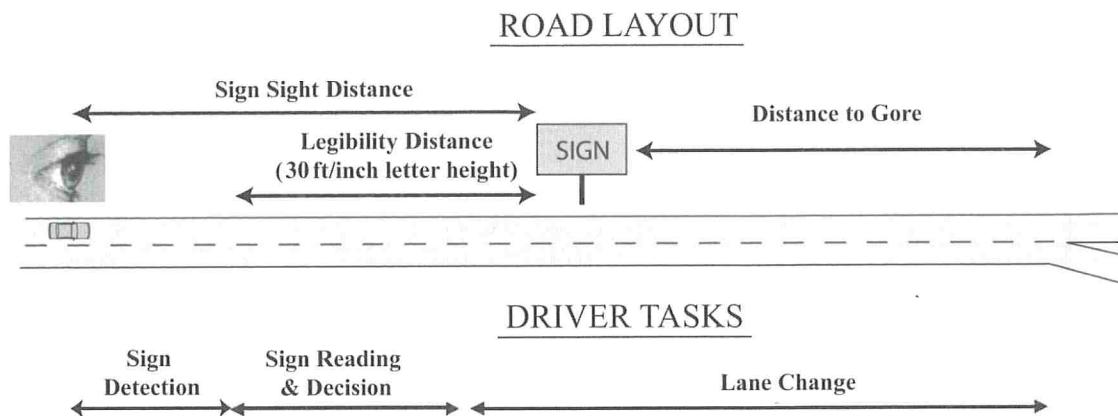


Figure 3.8. Stages of mental processing and reaction to road signs that illustrate MUTCD section 2A.13.

Minimum spacing of successive signs, such as terminal/airline information, can be calculated by allowing separation of a minimum 3 seconds travel at the operating speed. The following is an example:

$$\text{Speed} = 30 \text{ mph} = 44 \text{ ft/sec}$$

$$\text{Separation} = 3 \text{ seconds} * 44 \text{ ft/sec} = 132 \text{ ft}$$

This is a practical rule of thumb based on several considerations: (1) a study of changeable messages signs finding that the 85th percentile reading time, while driving, was 1 second per major word, (2) eye movement studies showing that drivers are reluctant to look away from the roadway for more than two seconds, and (3) the fact that trucks in an adjacent lane can block view of signs for several seconds. To allow for drivers to read several signs in succession, they should be spaced so as to allow time for each sign to be read, and to allow for drivers to look back at the road between signs.

Signs should be visible and located far enough in advance of decision points to allow drivers time to safely read the entire sign message and reach a decision on what to do (e.g., slow down in preparation for turning, change lanes) before reaching the turn or lane split. The more potential lane changes there are, the further in advance the sign must be located. A single lane change requires approximately 10 seconds for gap search and recognition (followed by the physical maneuver); two lane changes require 17 seconds and 3 lane changes 24 seconds¹³. The operating speed (which may be higher than the posted speed) should be used to determine appropriate sign placement.

The MUTCD advises in Section 2A.16 that regulatory and warning signs take precedence over guidance information. This section also contains advice on how to position signs on medians for situations where the roadway curves and how to position signs relative to sidewalks.

Refer to Section 3.5 regarding sign illumination and impact on sign legibility when considering sign spacing.

3.4.6.1 Regulatory and Warning Signs

The MUTCD is the source for information related to the design, use, and placement of regulatory and warning signs. The information is contained in the following chapters:

- Chapter 2B of the MUTCD contains provisions for regulatory signs, which are typically rectangular shaped signs and include Stop and Yield signs. Regulatory signs, as defined by the MUTCD, give notice to road users of traffic laws or regulations.

- Chapter 2C contains provisions for warning signs which are typically diamond shaped. Warning signs, as defined by the MUTCD, give notice to road users of a situation that might not be readily apparent.
- Section 2A.16 provides guidance for sign location in terms of distance from the edge of the road and sign height.

3.5 Sign Structures and Illumination

3.5.1 Sign Structures

Road signs can be ground mounted on the roadside or mounted overhead on sign structures. In general, signs should be located on the right side of the roadway (MUTCD Section 2A.16) so that they do the following:

- Are outside the clear zone unless placed on a breakaway support (see Section 3.5.2),
- Optimize nighttime visibility,
- Minimize the effects of mud splatter and debris,
- Do not obscure each other,
- Do not obscure the sight distance to approaching vehicles on the major street for drivers who are stopped on minor-street approaches, and
- Are not hidden from view.

For added emphasis, supplemental signs may be added to the left side of the roadway.

The MUTCD offers guidance on when overhead sign mounting may be justified (Section 2A.17). The following conditions (not in priority order) may be considered in an engineering study to determine if overhead signs would be beneficial:

- Traffic volume at or near capacity;
- Complex interchange design;
- Three or more lanes in each direction;
- Restricted sight distance;
- Closely spaced interchanges;
- Multi-lane exits;
- Large percentage of trucks;
- Street lighting background;
- High-speed traffic;
- Consistency of sign message location through a series of interchanges;
- Insufficient space for ground-mounted signs;
- Junction of two freeways; and
- Left exit ramps.

For airport applications, it is recommended that overhead signs be used for lane assignment on approach to terminal buildings, particularly for multi-lane facilities, and at any other locations where lane assignment is considered critical for safe and efficient roadway operations.

AASHTO offers guidance on sign support materials, types, design, and wind load ratings for large and small signs^{14,15}. These supports should be designed and located in a manner that maintains a safe roadside environment for all roadway users, and does not distract from the primary purpose of the signs which is to guide, warn and regulate traffic. For these reasons, architectural features and graphic treatments on sign structures (such as banners or other messaging) should be limited and carefully placed if used.

3.5.2 Safety Considerations

Sign structures should be mounted on breakaway supports or be shielded by guard rail. Roadway lighting luminaires should also be breakaway. The FHWA offers an informational guide to the various types of sign and lighting structures and supports¹⁶.

Signs should be placed off the roadway to allow a roadside clear zone to prevent errant vehicles from striking sign structures. If such a clear zone can't be provided because of limited right of way, large sign structures, including static and CMS signs, may need to be protected with crash cushions or guardrails. Additional information can be found in the AASHTO Roadside Design Guide¹⁷. Any roadway work zone device, such as temporary signs, barricades, and barrels, must meet crash worthiness standards as well^{18,19}.

3.5.3 Illumination

The MUTCD requires roadway signs to be illuminated or to use retroreflective materials in order to provide proper nighttime visibility. Because of the high ambient light levels along roadways in most major airports (from terminal buildings, parking garages, and landscaping) it may be necessary to use external or internal illumination to provide adequate nighttime visibility for roadway signs. At smaller airports or on the outlying areas of larger airports, with lower ambient light levels, high quality retroreflective materials may provide adequate visibility, particularly for ground-mounted signs. Nighttime testing on-site will be required to make these determinations.

The Illuminating Engineering Society provides guidance on roadway sign lighting²⁰. Other factors to consider when deciding between retroreflective materials and external or internal illumination are the following:

- Traffic volumes;
- Complexity of road geometries (i.e., retroreflective material typically works when used head-on, and is not ideal for curving roads);
- Obstructions of vehicle headlamps from one sign to the next due to closely spaced signs or landscape elements; and
- Need to emphasize decision points or critical information including terminal/airline listings.

3.5.3.1 Retroreflective Sign Sheeting

Retroreflective sign sheeting materials return light from vehicle headlamps to the driver's eyes. Retroreflection is achieved either through microscopic glass beads with a thin metallic backing or through microprisms in a thin polycarbonate film. These materials vary in the daytime color appearance and in their nighttime brightness and efficiency with which they reflect the vehicle headlamps. The FHWA and most states require a minimum level of retroreflectivity for all roadway signs and provide a toolkit to ensure these values are met²¹.

In some airports, the roadway horizontal and vertical geometry is such that considerable care must be taken by the designer in sign location and orientation to ensure that vehicle headlamps will adequately illuminate the sign along the necessary roadway sections.

The use of high quality retroreflective sheeting in place of external illumination may also help airports reduce electricity and maintenance costs and reach sustainability goals. Elimination of external illumination also reduces light pollution.

3.5.3.2 External Sign Illumination

Roadway lighting is addressed in a guide produced by AASHTO. This guide addresses sign lighting in different ambient lighting conditions. The guide recommends retaining external sign illumination in high ambient conditions. Most major airports would meet this condition²². Sign

lighting that is mounted at the top of a sign structure pointing down may cast shadows during the day that impair the legibility of the sign. Careful consideration must be given to placement of sign lighting to balance daytime appearance and any concerns over upward facing light in an airport environment due to stray light concerns.

Environmental conditions can affect sign visibility as well. Frost and dew forming on sign faces can render retroreflective material ineffective²³. These conditions are typically transient, and the material recovers without intervention. In areas of high humidity and frequent frost or dew conditions, sign lighting may be required to overcome this material deficiency.

3.5.3.3 Internal Illumination

Internally illuminated signs can be designed to provide sign recognition and legibility distances comparable to those that are externally illuminated. Proper materials and design must be used for the specific viewing angles present for a specific sign location. Candidate sign materials should be viewed in daylight and dusk conditions to ensure that there is adequate contrast when the sign is not lit. Internally illuminated signs might also help address concerns with stray light expressed with external illumination.

3.6 Changeable Message Signs

A Changeable Message Sign (CMS) is a lighted matrix sign that is capable of displaying messages that may be difficult to communicate with standard static signing. These signs are also referred to as Dynamic Message Signs (DMS) or Variable Message Signs (VMS), and these terms are used interchangeably throughout this section. These signs can be mounted in a permanent manner beside or over a roadway, or they may be placed on portable trailers. Small CMS signs may also be placed within a larger static sign, such as when available parking spaces are displayed. Examples of CMS signs are shown in Figures 3.9 and 3.10.

3.6.1 Appropriate Use of Changeable Message Signs

The primary function of a CMS is to alert and inform motorists of changing or temporary conditions along their travel path. Changeable signs on major roads should be used only to convey messages that change on an hourly, daily, or weekly basis, such as:

- Traffic conditions and roadway delays,
- Construction or maintenance lane closures or speed reductions, and
- Homeland Security threat level.



Figure 3.9. Example of CMS parking information (photos courtesy of Daktronics, Inc.).



Photo credit: Chris Cunningham

Figure 3.10. Tampa International Airport economy parking garage.

In other locations CMS may be used for:

- Parking availability and
- Parking fee schedules.

3.6.1.1 CMS vs. Static Sign

Changeable signs should be used where they are clearly beneficial to accommodate a changing state of operations and to provide convenient and timely information to the passengers and patrons.

It is FHWA policy that the appropriate use of a CMS and other types of real-time displays on the normal roadway system should be limited to managing travel, controlling and diverting traffic, identifying current and anticipated roadway conditions, or regulating access to specific lanes or the entire roadway²⁴. Airports represent a different environment that has not been investigated by FHWA, but many of the same principles and guidance exist in those applications as well.

CMS are one of the primary links between a transportation agency and those using the transportation facility. The design, display, and management of messages on CMS introduce many challenges for transportation agencies, airports included. Some of these challenges are addressed in *The Dynamic Message Sign Message Design and Display Manual*²⁵ and *The Portable Changeable Message Sign Handbook*²⁶. These documents provide comprehensive information on the use of changeable message signs in the typical roadway environment and will be helpful in assessing the use of these signs for an airport.

In any case, the CMS should not replace permanent, static signing required in the MUTCD. For construction activities, portable, trailer mounted CMS may be used.

A CMS can be an effective permanent and/or temporary traffic control device when used appropriately and coordinated with static signing systems. However, this effect can be diminished if this device is overused or improperly used. Each airport operator should establish or

endorse a written policy regarding the use of CMS and the authority to display messages should be limited. Many state transportation agencies have published CMS guidelines that may be helpful references.

3.6.2 CMS Technology

Each sign consists of a sign face, the sign housing, and a controller. The signs can be permanent or portable. Permanent signs can vary in size, but normally can display three lines of text with 12 to 18 characters per line. Portable CMS typically have a modular display consisting of three lines of eight characters each. New full matrix sign displays provide the most flexibility, including the ability to vary the height of the characters, display simple graphics, and use proportionally spaced fonts.

The most common types of lights used in CMS include: light-emitting diode (LED), fiber optic, incandescent bulb, and reflective disk. A description of these sign types is included in the Texas Transportation Institute (TTI)'s Guidelines on the Use and Operation of Changeable Message Signs²⁷.

Control of the sign display can be accomplished via direct connection with a laptop or any number of other methods via a remote computer communicating through an Ethernet modem connection over copper cables, fiber optic cable, radio frequency (RF) links, or cellular transmission. In any case, the use of National Transportation Communications for ITS Protocol (NTCIP) is required to comply with ITS industry communication standards.

3.6.3 Message Design and Layout

When CMS are used on airport roadways, their messages must also be carefully constructed to avoid information overload. A CMS must communicate a meaningful message that can be read and understood by motorists within a very short time period. A motorist's ability to read and understand a message depends upon the message load, which refers to the units of information in the total message. CMS messages must also "fit" within and work with the static sign system layout.

Lighting conditions vary throughout the day, based on the position of the sun and driver relative to the message sign, and can impact the driver's ability to read a CMS. Common lighting conditions include: mid-day (sun is overhead), washout (sun is behind driver), backlight (sun is behind sign), and nighttime (no sun). Attention should be given to ensure that CMS messages are readable under prevailing lighting conditions at the location at which they are intended to be used. MUTCD requires that CMS automatically adjust their brightness levels to account for varying light conditions.

Other message design features include message content, length, and format. Message content refers to specific information displayed on a CMS. Key elements of message content include information about the event or problem ahead and what the motorist should do about it. Messages are most often displayed in one or two multi-unit message phases. Although the use of three phases is possible, it is not recommended. For roadway applications, FHWA recommends the following guidelines for CMS message phases:

- Single Phase Display
 - Line 1—Describe the problem.
 - Line 2—Identify location or distance ahead.
 - Line 3—Provide motorist instruction.
- Two-Phase Display
 - Phase 1—Describe the problem.
 - Phase 2—Provide motorist instruction.

Message length refers to either the number of words or the number of characters and spaces in a CMS message. With obvious limitations on CMS line capacity, it is usually necessary to determine if the message will fit, then decide if abbreviations can be used or redundant words can be eliminated. Acceptable phrases and abbreviations should be well documented in the airport operator's policy regarding the use of CMS. Table 1A-2 of the 2009 MUTCD gives acceptable abbreviations for use on changeable message signs.

Message format refers to the order and arrangement of the units of information on a CMS. Motorist comprehension and decision-making is enhanced when the proper information is presented in the expected order. Poor formatting can result in driver confusion and increased reading times.

More information regarding message content, length, and format can be found in *The Dynamic Message Sign Message Design and Display Manual*, *The Portable Changeable Message Sign Handbook*, and the 2009 MUTCD.

Each phase of a CMS should be displayed long enough to allow the motorist to read it; however, unnecessarily long display times should be avoided. A phase refers to a message segment that is individually displayed, for example, the first phase may be "Road Work Ahead" and the second phase "Speed Limit 30 mph."

The following display times are recommended in Section 2L.04 of the 2009 MUTCD:

Guidance:

- The minimum time that an individual phase is displayed should be based on 1 second per word or 2 seconds per unit of information, whichever produces a lesser value. The display time for a phase should never be less than 2 seconds.
- The maximum cycle time of a two-phase message should be 8 seconds.
- The duration between the display of two phases should not exceed 0.3 seconds.
- Compatible units of information should be displayed on the same message phase.

Two phases should only be used when absolutely necessary and when both phases contain no more than one unit of information (i.e., the answer to a What? Where? When? question constitutes one unit of information.) Since drivers may first be able to read sign just at the moment the phase changes, the sign letter height, in combination with operating speed, must be designed so that the driver has the opportunity to read three phases per message for a two-phase message. Drivers require at least two seconds of display time per unit of information. A 16-inch letter height sign can be read at a distance of 480 ft (legibility distance is 30 feet per inch of letter height). To display a message with three phases each requiring two seconds, for a total of six seconds, the maximum operating speed would be 55 mph ($480/6 = 80$ ft/sec, or 55 mph).

3.6.4 CMS Display Elements

3.6.4.1 Letter Size

Legibility experiments of CMS character matrix technology had indicated that 18-inch characters can be read far enough away by most drivers in optimum daytime viewing conditions to provide 8 seconds of available viewing time while traveling at 70 mph. Another legibility study found that 12-inch characters were sufficient at 45 mph during optimum conditions²⁸. However, optimum conditions often do not exist due to weather and/or other factors.

The MUTCD provides further guidance regarding letter height in Section 2L.04:

Word messages on changeable message signs should be composed of all upper-case letters. The minimum letter height should be 18-inches (450 mm) for changeable message signs on roadways with speed limit of 45 mph (70 km/h) or higher.

Based on this information, a minimum letter height of 12 inches is recommended for roadways with operating speeds less than 45 mph, and 18 inches for roadways with operating speeds of 45 mph or more. Recommended letter heights are shown in Figure 3.11.

3.6.4.2 Font

New CMS technologies allow denser pixel placement and a wider variety of fonts and letter forms than in the past. The MUTCD does not specify a font to be used on CMS. It does provide guidance statements that encourage minimum visibility and legibility distances in Section 2L03 Paragraph 4. Additional sections (2L04) provide guidance on letter stroke width, height: width ratio, character spacing, and use of upper and lower case letters.

3.6.4.3 Color

Typical roadway CMS signs generally contain white, yellow, amber, or fluorescent yellow-green legends on a black background. Full matrix LED sign displays are also capable of displaying full color text and graphics, but use of some of these colors may actually increase driver recognition and comprehension times. Although these colors may have greater target value than other colors, the novelty of these signs may prevent their recognition as traffic control devices.

The sign structural support and housing materials should be selected with care so as not to distract from the message being displayed. The housing should also be neutral enough that the CMS is recognized by drivers as a traffic control device and not an advertisement.

In support of this concept, the MUTCD contains the following language in Section 2L02:

Standard: When a changeable message sign is used to display a safety, transportation-related, emergency homeland security, or AMBER alert message, the display format shall not be of a type that could be considered similar to advertising displays.

Research shows that white or amber is preferred for CMS letter colors. The use of red is not recommended.

In addition, Section 2L04 of the MUTCD discourages the use of CMS in a manner that may be distracting to drivers:

Standard: Changeable message signs shall not include advertising, animation, rapid flashing, dissolving, exploding, scrolling, or other dynamic elements.

3.6.5 Passenger Advisory CMS

With security taking a high priority in airport activities, there is a need to communicate elevated risks to travelers. The Homeland Security Advisory System uses a color-coded system to place citizens and public officials on notice about the likelihood of a terrorist attack. The more specific and imminent the threat, the higher the threat level is set. The threat level changes periodically, so changeable message signs can offer an avenue for communicating these changes in the airport environment.

If public agencies decide to display emergency or security alert messages on a CMS, FHWA has determined that this application is acceptable if public agencies have developed policies and procedures that govern the messages that are displayed on CMS and their operation. The public agency policy and procedures relating to displaying emergency or security alert messages on CMS must address the following issues:

An FHWA memorandum dated March 21, 2003, addresses Use of Changeable Message Sign (CMS) for Emergency Security Messages⁶⁴:

- The criteria under which CMS will be used for emergency or security alert messages, including the necessary coordination with public safety or security agencies. Formal policies among

Operating Speed (mph)	Recommended Letter Height (inches)
Less than 45 mph	12
45 mph or more	18

Figure 3.11. Recommended CMS letter heights.

critical stakeholders (such as law enforcement, security, transportation, and public safety) can be used to establish these agreed upon criteria.

- Protocols or hierarchy for prioritizing messages and determining which messages are to be displayed.
- Geographic area over which the information is to be displayed, to be determined in cooperation with public safety and security agencies.
- Identification of the circumstances under which transportation-related messages, such as lane closures, fog alerts, detours, or other messages that may be needed because of dangerous travel conditions in the immediate vicinity, would preempt emergency or security alert messages.
- The criteria that would cause the discontinuation of use of the CMS if the emergency or security alert message creates an adverse traffic impact such as queues, markedly slowing traffic, etc.
- Methodology for developing and displaying messages that are appropriate for CMS display including, but not limited to, standard message sets. Agencies should follow the recommended national CMS practices related to the development, use of text, manner in which messages should be displayed, human factors related to understandability of the messages, and how CMS are operated.

3.7 Sign Maintenance

In 2008, FHWA passed rules concerning minimum sign retroreflectivity values. These are listed in Table 2A-3 of the MUTCD. These standards require a sign maintenance plan that ensures that minimum levels of retroreflectivity are maintained to provide adequate visibility. The following five different methods of regular inspection of sign retroreflectivity are allowed:

- Visual nighttime inspections,
- Measured retroreflectivity,
- Expected life,
- Blanket replacement, and
- Control signs.

Sign retroreflectivity can be incorporated into an overall asset management plan. Expected life of sign materials and structures can be included in the plan to expedite routine replacement and maintenance. The retroreflective material on a sign can be expected to last 7–12 years depending on the type of material selected and its sun exposure.

Ground-mounted signs may need to be cleaned annually to remove dirt and mud, particularly those in splash zones and near areas where vehicle idling may produce soot build-up. Annual daytime and nighttime visual drive-by inspections are recommended as part of a maintenance schedule.

Sign supports, crash cushions, and guardrails may need routine maintenance and inspection as well depending on the system used. Manufacturer's recommendations should be followed to check for rust, loose bolts, etc.



CHAPTER 4

Parking

At one time, parking was just a necessary function airports had to provide their patrons, but was little more than an afterthought compared with terminals and runways. Today, parking is one of the largest sources of unencumbered revenue for an airport as well as one of its largest sources of complaints by travelers—and the employees. Fortunately, signing as it relates to parking is now reaping the benefits of both careful planning and technology. Airports (as well as other major transportation hubs) are using a user-perspective approach where adequate information is delivered at the necessary locations in the appropriate form.

In fact, even some of today's well-planned wayfinding designs can get lost in translation. For example, at Schiphol, Bureau Mijksenaar tested a new wayfinding system in the airport's three parking lots (previously a confusing mix of colors that passengers had difficulty remembering or differentiating.).

The design firm used symbols, rather than pictograms, with three themes—Holland, sports, and international cities—and every parking section was denoted by a corresponding mascot (such as the Statue of Liberty, etc.). Unfortunately, the test group didn't understand many international city icons, so the firm swapped the city icons for more recognizable transportation symbols, along with the sports and Holland themes, and the system is now very successful.

4.1 Considering Parking Users in Design (Human Factors)

The approach to designing a signing system for parking functions is similar to signing in other areas: understand the user's needs. Parking signing is unique, however, in that you have to provide wayfinding for the driver (e.g., inside the vehicle) and pedestrian (outside the vehicle) within the same environment. Regardless of the person's mode, wayfinding must give each type of user information as to the:

- Destination (where one wants to go),
- Designation (where one is currently), and
- Direction (how to go from one to the other).

In general, the human factor aspects of signing for parking at airports follow the same principles as necessary for all signing at airports: simplicity, consistency, continuity, and redundancy. Focus groups of users can be valuable sources of input as airports embark on signing makeovers.

Parking garage users include both drivers and, once they have exited their vehicles, pedestrians. Drivers require sign guidance in order to navigate to a suitable location within the parking

facility. Many airport facilities offer short-term parking that is located closer to the terminal at a higher cost, and long-term parking further away from the terminal at a lower cost. Larger airports may also divide their parking facilities into sectors such as domestic and international departures in order to provide a closer connection with the appropriate areas of the adjacent terminal building. Some airports have as many as eight different parking options. Posting rates in advance of decision points can help drivers make an informed decision about where to park. The challenge is to do so without overloading the motorist with information. In addition, drivers need to know which parking areas are full and which have parking spots available. Within the parking facility, signs and pavement markings directing drivers need to be clear about the direction of traffic (e.g., one-way only or two-way) and the direction to follow to find more parking or to find the exit.

As pedestrians, parking users need to remember the level, aisle, and sometimes which garage or lot where they have left their vehicle. There are a number of memory aids that can assist parking lot users to remember where they parked their car. Different levels can be associated with different colors, images, and alphanumeric characters, and in addition each parking spot can be numbered with the hope that at least one of these memory aids will be remembered.

In addition, as the use of automated payment stations—often referred to as pay-on-foot stations—proliferates at airports, it becomes necessary to remind patrons to take their parking tickets with them versus leaving them in their vehicle. Since the pay stations are often located at a consolidated location where pedestrians easily pass before returning to their vehicles, encouraging patrons to keep their parking tickets with them is as much a customer service activity as it is informational to make exiting a parking facility more efficient.

After leaving their parking spot, pedestrians need to be directed along a safe path to access points to the appropriate terminal entrance. Signs showing the pedestrian exit and terminal access have to be clearly distinguishable, by size, color, placement and design from signs intended for drivers. Crosswalks need to be well-marked using signs and pavement markings for both pedestrians and drivers. Pedestrians require similar guidance upon returning to the parking facility from the terminal. Method of payment, whether pay on foot or pay upon exit from the facility, must also be made clear. It may be necessary to remind patrons to pay for their parking at a pay station within the terminal (or some other location) before proceeding to their vehicles and exiting the parking facility. From the terminal building, they need to be guided to the appropriate sector of the parking facility, and crossing points with roadways need to be well-marked. Assistance phones to help drivers having difficulty finding their car should be well marked.

4.2 Signs and Wayfinding

4.2.1 Planning for Parking Signing

A comprehensive signing program for parking encompasses the moment a person enters the airport grounds and can continue past the exit plazas. To provide an overview of the elements to consider when planning parking signing, Figure 4.1 represents a checklist to aid in the discussion.

Additional thoughts for consideration:

- Use light as a wayfinding tool to highlight key destination points such as elevators and connector bridge access points (Figure 4.2).
- Select sign colors that can be distinguished under different types of lighting conditions.
- Provide an adequate number of level and row markers throughout the garage.

Area	Items
Airport Entry	<ul style="list-style-type: none"> • Naming of parking facilities/options <ul style="list-style-type: none"> - Impacts roadway signs (sizing, mounting structure, etc.) - Consider regional expectations (e.g., should you use "Long Term" or "Daily".) • Parking rates <ul style="list-style-type: none"> - Aids decision-making
Entry to Parking Facility	<ul style="list-style-type: none"> • Garage or lot identification • Parking status <ul style="list-style-type: none"> - Basic: Open or Full - Detail: Number of spaces available and their location • Parking regulations • Towing policies and contact number • Parking rates <ul style="list-style-type: none"> - Preferably post prior to entry with sufficient time/space to exit out of the parking entrance lane if driver elects not to park after seeing rates. • Speed limit within parking facility • Height restrictions/warnings • Notice to watch for pedestrians
Vehicular Perspective	<ul style="list-style-type: none"> • Directional signs to destinations <ul style="list-style-type: none"> - Park - Exit - Location - Materials - Message Symbols • Parking Designations <ul style="list-style-type: none"> - No parking - Handicap parking - Reserved parking - Maximum 1-hour parking • Mounting considerations • Regulatory and traffic control
Pedestrian Perspective	<ul style="list-style-type: none"> • Level/section/aisle identification • Pay-on-foot messages • Trailblazer directional signs to destinations <ul style="list-style-type: none"> - To terminal - To baggage claim - To stairs - To elevators • Informational signs <ul style="list-style-type: none"> - Assistance/emergency call boxes - Automated External Defibrillators - No smoking • Mounting/placement considerations
Exit from Parking Facility	<ul style="list-style-type: none"> • Exit lane identification <ul style="list-style-type: none"> - Cash only - Credit only - Express exit • Parking rates • Directions after exiting <ul style="list-style-type: none"> - Return to terminal - Airport exit

Figure 4.1. Parking signage checklist.

- Use the elevators as a touch point to reinforce where the user parked noting the color, level, zone, etc.
- Repeat parking level colors and themes inside the cab next to the call buttons.
- If themed icons are used as a memory aid they must all be unique in order to be memorable. Avoid using like categories as in each level is themed after a flower.
- The larger and more complex the garage is the more redundant the memory aids will need to be.
- Garages that park cars on the ramps will require special attention in determining where the levels change to avoid unnecessary confusion.

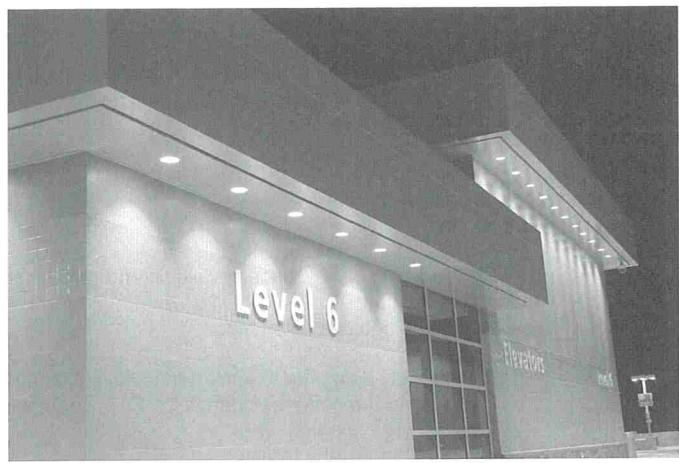


Photo credit: Chris Cunningham

Figure 4.2. Effective use of lighting to call attention to key destinations like the elevators at TPA.

4.2.2 Communicating Parking Options

To locate the parking facilities for the general public, use the word “PARKING.” To identify specific parking lots, use the following terms:

- HOURLY—for short periods of time, less than 24 hours.
- DAILY—for periods of 24 hours or more.
- REMOTE/ECONOMY—for outlying daily lots, Park & Ride, etc.
- VALET—for assisted parking.
- METERED—for coin operated spaces.
- GARAGE—which can then be separated into Hourly or Daily, as appropriate.
- CELL PHONE LOT—for non-pay parking facilities where a driver is waiting for a phone call to pick up a passenger at the curbside.

If parking lots or garages are related to multi-terminal complexes, other terminology may apply, such as: PARKING—TERMINAL 1 (or A), PARKING—TERMINAL 2 (or B), etc. The parking garage that serves multiple terminals may require a “CENTRAL GARAGE” designation.

Alternate terminology for “Hourly” is “Short-Term,” and for “Daily” is “Long-Term.”

The Identification and Evaluation of Guide Signing for Airport Roadways with Specific Application to Dallas/Ft. Worth International Airport recommends these same terms, with slight exceptions²⁹.

4.2.3 Connecting Parking and Terminals

In most cases, the terminal is the primary destination for a person entering a parking facility. Depending on the distance of the parking facility from the terminal and the physical configuration of the parking facility and the terminal, a person will use one of the following methods to move to and from parking and airport terminals:

- Shuttle buses,
- Cross walks,
- Sky bridges,
- Elevators/escalators/stairs, and
- People mover systems.

Signage to identify and direct patrons to these terminal-access locations must be presented to pedestrians, e.g., after a person has parked their vehicle and needs to proceed to a terminal. Signs

must be consistent with color and other graphical elements used throughout the parking facility. In most cases, the only identification that should be provided is the phrase "To Terminal" (or "To Terminal 1," "To Terminal A," etc.) with the appropriate directional arrow.

4.3 Sign Categories

The sign type family is the catalog of all directional, identification, and informational signing applications. It functions as a tool for programming signs and allows for a much more effective process. This section includes primary and secondary sign types for:

- **Directional Signs**—Signing designed to facilitate circulation to and/or from a specific parking facility.
- **Identification Signs**—Signing designed for identification of specific parking products or areas within parking facilities and pathways to terminals.
- **Informational Signs**—Signs or displays designed to convey airport information and services. Directories of floor plans, levels, terminals, airlines, gates information, etc.
- **Regulatory Signs**—Signs for traffic control, fire exits, stairs, parking reserved for people with disabilities, etc.

4.3.1 Directional

This addresses the information process that enables passengers and visitors to select the proper path to meet their needs, when to determine a decision point, and where to identify specific services and various functional areas such as the location of parking pay stations.

Directional signing is of greatest importance in airport parking facilities. All other signs are subordinate. Proper directional signing is necessary because the rapid movement of vehicles, people, and particularly the passenger is essential for maximum utilization of the parking area. Success or failure of the operations and its signing is largely measured by the ease, speed, and comfort of going from parking to the terminal or the other way around. In addition to traditional signing considerations for the conventional passenger, directional signing is paramount to those persons arriving late for a flight, persons with disabilities, and non-English speaking passengers.

Primary messages for vehicular directional signs are PARK and EXIT. Vehicular directional signs are typically placed above the lowest structural beam, which can create poor sight lines. On overhead directional signs, the message should be placed as close to the bottom of the sign panel as possible to improve the visibility by improving the sight lines, as shown in Figure 4.3.

4.3.1.1 Vehicular

Viewer circulation patterns and natural lines of vision are the basis for determining the location of all signs. Signs shall be located to precede decision points to ensure sufficient time for vehicles to react to each sign message.

Note the orientation of the arrows in regards to vehicular directional signing. When it is desired to have vehicles proceed in a straight direction, the arrow should be pointing down, similar to the orientation of arrows on roadway signs. In addition, the arrow on the sign should be

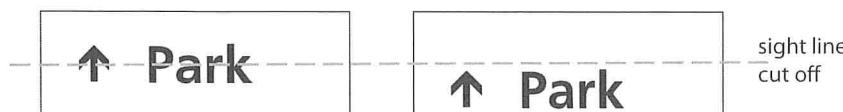


Figure 4.3. On overhead directional signs, the message should be placed as close to the bottom of the sign panel as possible to improve the visibility by improving the sight lines.

placed over the center of the drive aisle. Although it may seem counterintuitive on ramps that go physically up, the arrows over the travel lane should still point down to indicate the message to continue driving forward. Vehicular directional signs should be centered over the drive aisle and are larger and more visible than a pedestrian directional sign. Examples of parking arrows that illustrate the best practices for parking sign location are shown in Figure 4.4.

4.3.1.2 Pedestrian

Viewer circulation patterns and natural lines of vision are the basis for determining the location of all signs. Signs shall be located to precede decision points to ensure sufficient time for passengers to react to each sign message.

Contrary to the arrow orientation for vehicles, the arrow should point up on directional signing for pedestrians when the need is to send people straight ahead. Yet similar to vehicular directional arrows, it is helpful when the arrow is placed over the desired pedestrian pathway. Pedestrian directional signs should be placed adjacent to the drive aisles and are smaller than a vehicular directional sign to avoid competing for a driver's attention.

4.3.2 Identification

Proper identification of the various parking products and destinations is essential to the customer experience. As the choices continue to expand, the task of remembering where you parked

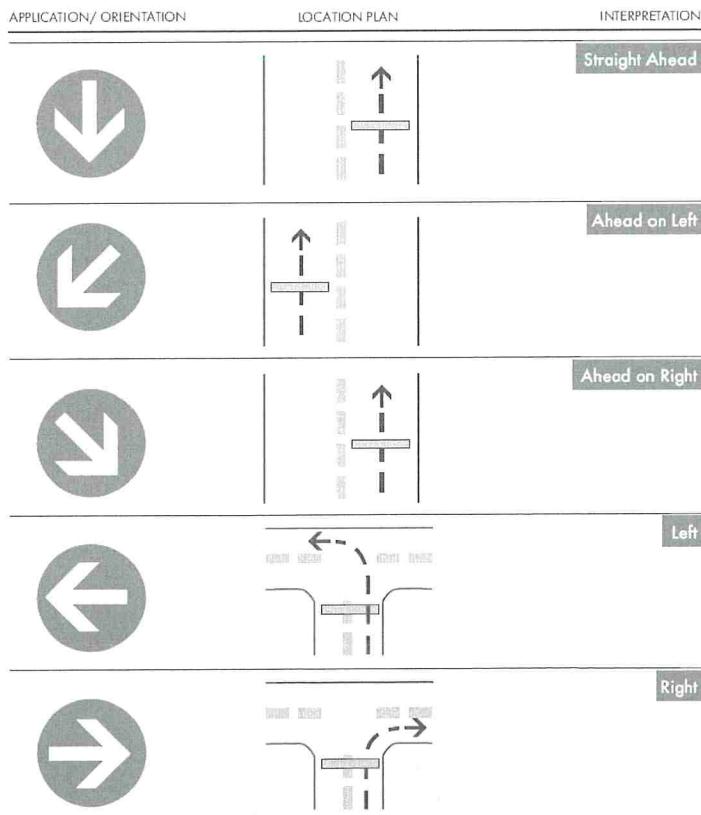


Figure 4.4. Examples of parking arrow applications.
Source: Boston Logan International Airport "Signage Standards and Guidelines Volume 3—Parking," August 2005.

becomes increasingly challenging. Identification signs also mark the location of items such as stairs, elevators, sky bridges to specific terminals, etc.

4.3.2.1 Toll Plaza

Depending on the type of parking management system used by an airport and other operational preferences, signing near and at a toll plaza should be mounted overhead and highly visible.

At an entry plaza, signing should clearly identify the parking facility being entered (e.g., daily, hourly, etc.). In addition, the fee schedule should be posted in a manner so that patrons can clearly see the effective charges for use of the facility. If it is not possible to post the rates in a legible manner directly on the ticket issue machine (or card reader), then the fee schedule should be mounted adjacent to the equipment. It is not advisable to post other regulatory information near the entry equipment; this could reduce the efficiency of the entry plaza due to patrons attempting to read all the information and causing queues. Such regulatory signs could include information about the acceptance of liability for using the facility or similar information.

At exit plazas, signing can be used to improve operations. By placing large signing above each lane of the exit plaza that clearly identifies what functions can be performed in that lane, this allows patrons to self-select where they need to go to complete their transaction. Not only should the sign indicate if a lane is “open” or “closed,” it should also identify if the lane is “cash only,” “cash & credit,” or some form of a pre-paid “express lane.” Using some form of changeable message displays above each lane maximizes the operational flexibility of the exit plaza.

4.3.2.2 Payment Options

It is becoming an increasingly common feature at airports that payment for parking is made prior to a patron returning to their vehicle within a parking facility. Such payment stations are most often placed so that patrons must pass one payment station, or a bank of payment stations, just prior to entering the parking facility. Be it at the end of a sky bridge, prior to exiting the terminal, at a shuttle bus shelter, or in an elevator lobby, signing should clearly identify the location of the pay stations.

Since payment for parking is an operational function and not a regulatory one, more flexibility is provided to airports in what the pay stations are called and what signing is provided. Some airports brand this type of payment and exiting option with terms such as “Express Pay” or “Pay-and-Go” and the associated signing is more in-line with advertisement with specific graphics and colors. Airports should still use the conventional and internationally accepted logos in conjunction with these other forms of signing.

With pay-on-foot operations, parking rates can be placed on a placard directly on the pay station, or displayed via a monitor incorporated into the pay station. Airports need to take into consideration ADA requirements with pay stations and provide equipment at the appropriate height and legibility.

Even if pay stations are provided prior to exiting, it is desirable to post the parking rate schedule at the exit lanes. This reminds individuals what they should pay for the durations of their parking and to prepare their ticket for payment. This makes for a speedier exit, which increases the efficiency of the exit plaza.

4.3.3 Informational

Informational signing has less importance than directional signing in parking facilities. These signs provide specific details such as: “You Are Here” maps, parking operation offices, special assistance, and similar types. The intent of these signs is to help individuals satisfy needs not

directly related to finding a parking space, exiting the parking facility, or moving to the appropriate terminal. Informational signs also address requirements issued by local, state, or federal agencies that must be posted and visible to the public.

Examples of informational signing that should be posted include the following:

- No smoking signs,
- Towing enforcement policies and who to contact to retrieve vehicles,
- Required city/local regulations and laws, and
- ADA required signs.

4.3.3.1 Directories

The primary objective of directories in airports is to provide the passenger with an overall orientation of the terminal, parking, and other facilities. Another objective of a directory is to help the movement of passengers to and from their destinations with ease and efficiency. In most cases, it is a supplement to the existing sign system. It is important that the individual needs of each specific airport be considered in the planning of directory information units.

The development of directories can be a very expensive piece of the information system for airports. The effort required to determine accurate or representative graphic floor plans, space identification, symbols, color, text, supplemental information, enclosures, illumination, orientation architectural design compatibility, location, and overall implementation can be extensive as related to the overall cost of the individual units.

Color coding systems, used on some map directories to key terminal and parking buildings or levels, have proven very effective for complicated terminals and parking structures, but if not carefully done, color coding can make a basically simple terminal more confusing and complex. In most cases, simple, accurate line drawings of high quality may be the best solution for representing the floor plans. In addition, it has been proven more effective if the orientation of the map matches the actual orientation of the physical environment from the perspective of the user. In other words, always having the map oriented so that the top of the map is north may be highly confusing to the patron if this causes the map to be upside down compared to their actual surroundings.

Care should be taken in reviewing directory construction details to ensure a flexible and cost-efficient method for changing diagrammatic maps and alphabetical indexes. Maintaining an aesthetically acceptable appearance over the course of time is an equally important consideration in the directory unit design.

4.3.3.2 Flight Information Displays

Flight Information Displays (FIDs) provide complete flight related information regarding arrivals and departures and are common features within the terminal at various locations. It is becoming more common to find FIDs within parking facilities. When a parking garage serves multiple terminals, locating an FID system within the garage itself at locations prior to actually accessing a terminal allows users to verify to which terminal and gate area they should proceed. On the garage-side of a sky bridge would be an example of a location where providing FIDs would be helpful to patrons.

In addition, FIDs may be placed in remote parking facilities where shuttles, trams, or some other method transports users to terminals. FIDs would be especially helpful when the patron, for example, needs to select a specific shuttle or tram stop to go to a certain terminal.

4.3.3.3 Row/Level Markers and Other Visual Themes

For parking garages, each level should be numbered from the ground level and up with explanatory terminology added for clarification, such as, for example, "Terminal Level."

Aisle location signs need to be repeated sufficiently. For garages with lower ceilings, repeating the locator signing every two to four stalls may be required. In parking garages with higher ceiling clearances, placing locator information on the support columns is typically sufficient. In surface parking lots, mounting locator information on light poles is the most typical placement and also allows the signing to be placed higher which permits patrons to see them over the tops of almost all vehicles. Signs should also be located at the end of aisles and/or at the connection of an aisle to a walkway.

Visual themes are elements that trigger a person to identify where they parked. The most basic memory devices used are numbers, letters, and colors. These memory devices can become more creative and site-specific by incorporating graphics. Some airports are even incorporating music and sound cues to further the cognitive links to a specific parking area. Regardless of the visual memory devices selected, they should also be repeated on directional maps, at elevator lobbies, and even on the buttons of the elevator to further reinforce the message.

These identification systems are at the discretion of the airport and have a lot of flexibility. Practically no regulations are in place that restrict how simple or elaborate the system can be. It is accepted, however, that simple colors, symbols, and graphics are more effective. It is highly recommended that any identification scheme selected be tested within focus groups prior to the manufacturing and installation of signs. Consider schemes that provide images that are readily distinct and memorable. Avoid using images associated with a single category, where all the images are a type of flower, for instance. Figures 4.5 through 4.12 represent how memory aids can be deployed to help people remember where they parked.

4.3.4 Regulatory

Regulatory signs relate to local, state, and federal requirements such as traffic signs, ADA items, and safety devices such as fire exits and automatic external defibrillators (AED).

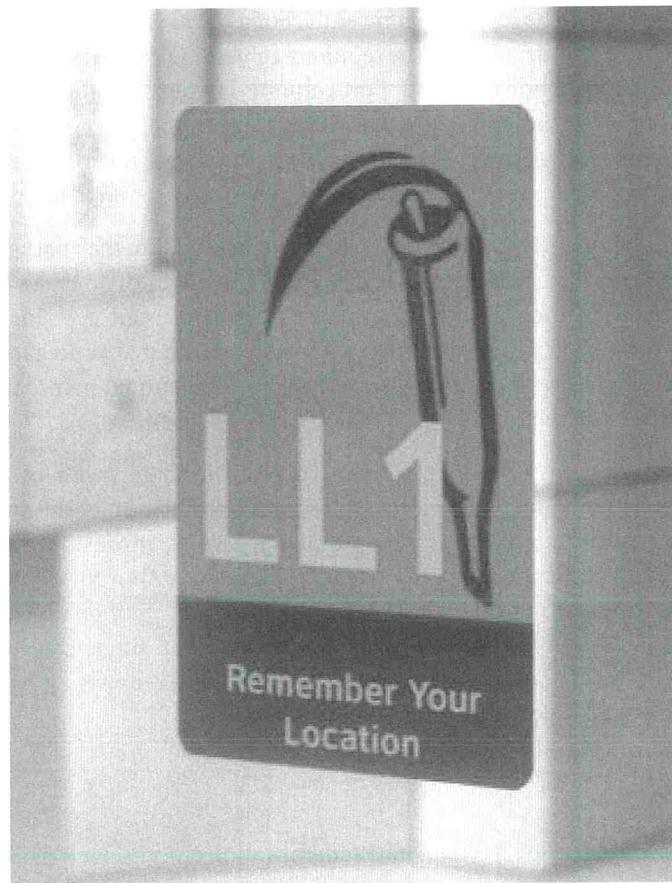
4.3.4.1 Emergency/Assistance Call Box Location

When an airport provides call boxes within the parking facilities, these should be clearly identifiable to both drivers and pedestrians. The placement of the call boxes is critical, and signing



Source: Naughton & Associates.

Figure 4.5. Row and level markers with pedestrian trailblazer information that is sized appropriately to not be confusing to motorists.



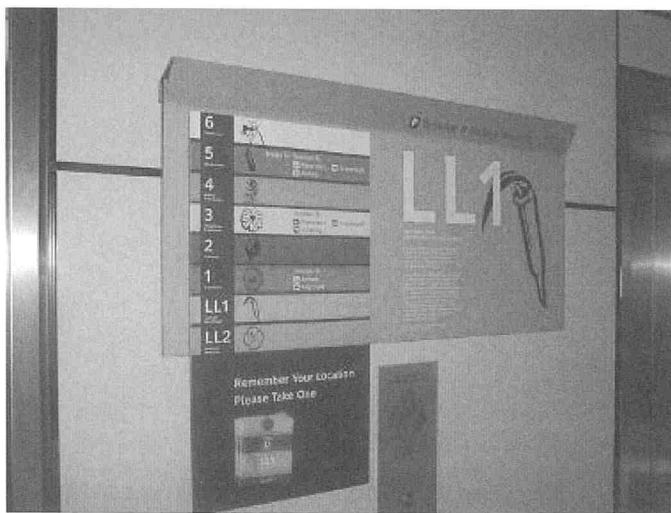
Source: Naughton & Associates.

Figure 4.6. Reminder on the glass doors to the elevator lobby.



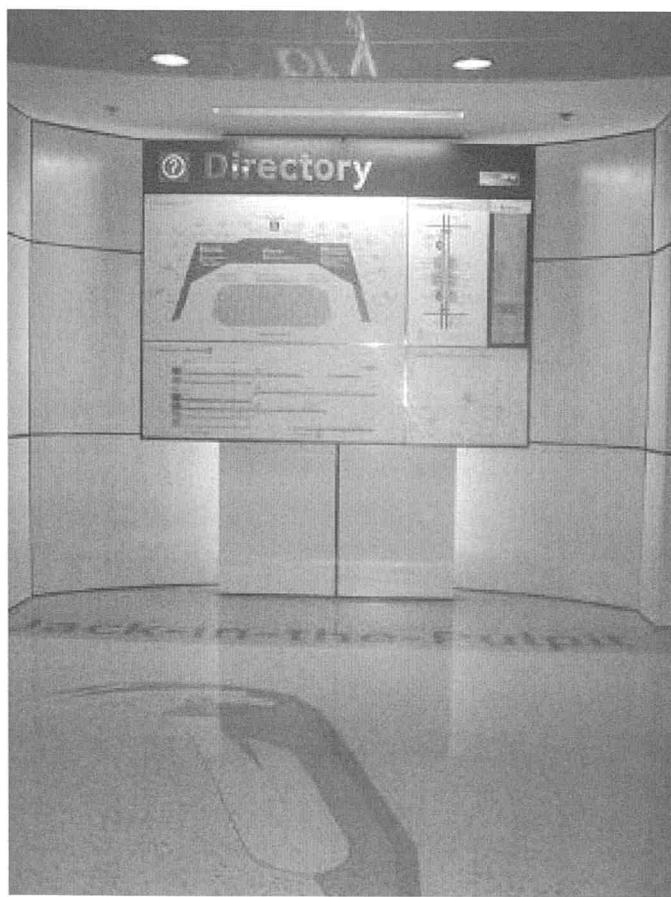
Source: Naughton & Associates.

Figure 4.7. Reinforcement of graphic theme memory tool at elevators.



Source: Naughton & Associates.

Figure 4.8. Reminder cards and garage level information next to the call button plate.



Source: Naughton & Associates.

Figure 4.9. Reinforcement of graphic theme memory tool inlaid into the elevator lobby floor.



Source: Naughton & Associates.

Figure 4.10. The wayfinding experience is continued inside the elevator cab. This type of sign is important for persons looking for their vehicle.

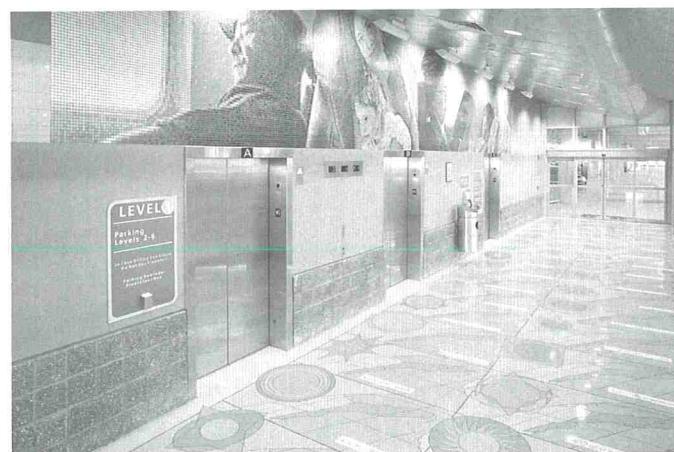


Photo credit: Chris Cunningham

Figure 4.11. Examples of artwork used as a memory tool device at TPA.



Figure 4.12. Example of inlaid floor graphic used to remind people where they parked at RIC.

cannot overcome poor planning. The placement of a blue-light beacon on or adjacent to the call boxes is often used to supplement signing.

Not only should signing be used to locate and identify call boxes, instructions should be placed so that a user can see how to use the call box, for example, if a code or telephone extension should be dialed to specific services such as police, fire, EMS, and vehicle assistance. Both the call box and instructions should comply with ADA regulations.

4.3.4.2 AED Location

Depending on local and state requirements, it may be necessary to place AEDs in a parking facility. It is best to place AEDs in areas where people would instinctually look for them. Examples of such locations include elevator lobbies, adjacent to emergency/assistance call boxes, and near FIDs or “You are here” locator maps.

Signage for AED locations, again, may be regulated by local or state law. At the minimum, signing should be placed so that an individual can see either the location or directional signs to AEDs over the tops of vehicles. By placing AEDs near emergency/assistance call boxes, a flashing beacon can be used to further draw attention to these medical devices.

4.3.5 Unique Situations and Systems

4.3.5.1 Cell Phone Lots

With the proliferation of mobile phones over the past decade, the concept of just-in-time delivery has progressed to just-in-time passenger pick-up at airports. Now that people are able to receive real-time information on a flight's arrival status, the need to guess when a flight might land and find a parking place to wait until it does arrive is dissipating. Airports have developed special areas for people to wait short periods of time in their vehicles until their family, friends, or business associates contact them via cell phone to pick them up at the terminal curbside. In the 2009 Survey, more than 74% of the airports indicated they provide some form of cell phone parking lots.

As previously mentioned, the terminology for these types of parking facilities varies and they are often branded by airports to encourage their use. Figure 4.13 illustrates some of the various signs used to identify this special type of parking area. Of 50 airports reviewed, over half of them had a cell phone lot. Of these airports, the name most often used is “cell phone lot.”

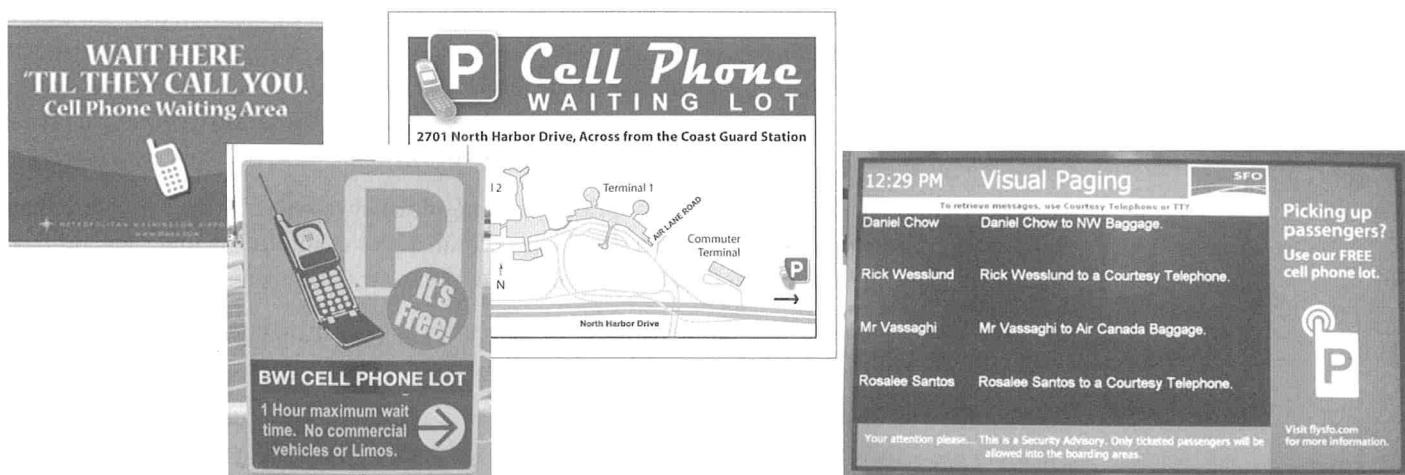


Figure 4.13. Examples of airport cell phone lot signage.

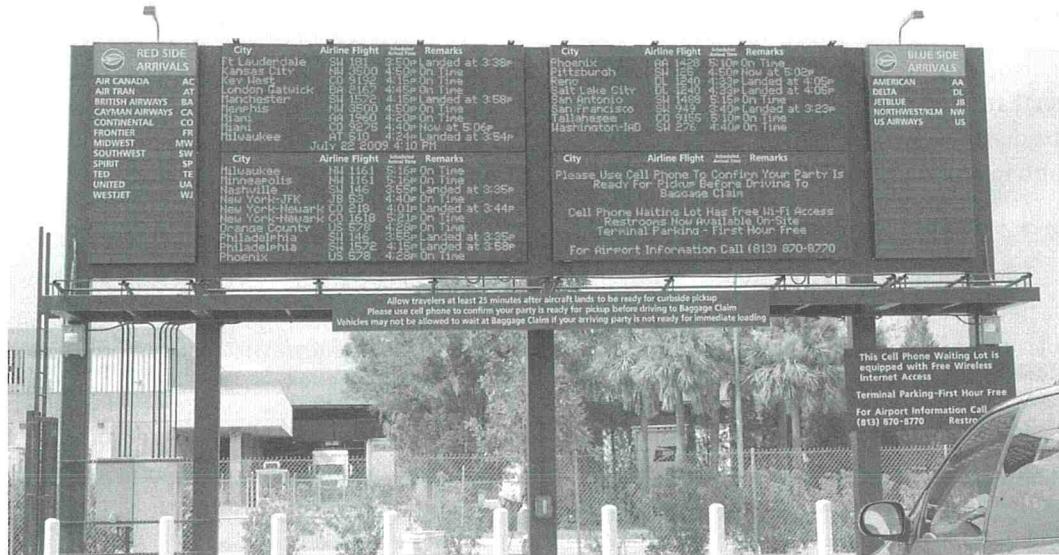


Figure 4.14. An example of MUFIDs at Cell Phone Lots (Tampa International Airport).

Because of their popularity and ability to de-congest terminal curbsides, some airports are providing dedicated information and amenities within the cell phone waiting areas. Flight information display boards, free wireless Internet, vending machines, and restrooms are the more common items. Figure 4.14 is an example of how FIDs at Cell Phone Lots provide current information to patrons. This encourages people to stay in the Cell Phone Lot and not circle the airport or congest terminal curbsides.

4.3.5.2 Advanced Parking Management Systems

One area where more information is being provided is the introduction of changeable signing and guidance systems within parking facilities to assist drivers in finding available parking spaces. The basic concept is that a series of sensors count vehicles as they enter and exit specified areas of a parking facility. These in/out counts are compared against the known number of parking spaces within each area whereby the number of vehicles parked in each zone can be calculated. As areas become full, this information is conveyed to drivers via changeable signs and in-pavement markers so that they can bypass the full areas and proceed to areas with available parking. The areas can be defined at the macro level (the entire parking facility), or at the micro level (individual parking spaces). In the 2009 Airport Sign Managers Survey, 55% of airports responding indicate they use some form of electronic car counting. Some airports display this information to the public, while other airports use the car count information internally to make operational decisions such as to place cones or barricades to block off areas of a parking facility.

There should be no more than four options lines on one roadway sign. If there are more than four parking options, the information should be separated. For example, the first sign could be daily and hourly parking, and the second economy and remote parking, in that sequence.

Figures 4.15 through 4.19 show examples of various types of information being provided and where it is provided.

London Heathrow International Airport deployed a system to take customer assistance to another level. Instead of merely helping people finding a parking space, Heathrow has a system in their Terminal 5 Parking Structure to assist with locating your vehicle after one's trip. Figure 4.20 is the graphic the British Airport Authority uses to explain how the technology works.



Figure 4.15. Roadway sign providing information as to the availability of parking in each parking facility. The information is provided prior to the decision point where driver must travel (Reagan National Airport).



Figure 4.16. A parking availability sign that is placed immediately after the access controlled entrance plaza indicating to drivers the number of parking spaces available on each floor of the parking structure (SEA-TAC Airport). Note: Although the signage is useful and located in the correct location, if the information displayed is not current and accurate, drivers will soon discredit the information and the signage becomes useless.



Figure 4.17. Once inside the garage additional signs indicate the availability of parking within a particular area. In this case, areas are defined by groups of parking aisles. (SEA)



Figure 4.18. The informational signage associated with a "space management system" that directs drivers to specific available parking spaces.



Figure 4.19. Once inside the parking garage, the space management system uses a series of signs to indicate which areas have available parking. Then sensors located above each parking space use red and green indicator lights to inform drivers if a particular space is occupied or not.

These Advanced Parking Management Systems (APMS) are gaining popularity at airports and collective guidance has been provided by the Federal Highway Administration regarding APMS⁶⁵. This document is informative in the topics of describing the state-of-the-practice, recommendations for planning APMS, and other implementation items. The guidebook generally discusses signing but does not provide specific details regarding sign content, form or placement. In fact, specifics and recommendations on signing associated with APMS are often suggested by vendors providing the APMS.

4.4 Sign Design Elements

The 2009 MUTCD contains information regarding signs and pavement markings in the public drive aisles of parking facilities. Although the 2009 MUTCD does not specifically address

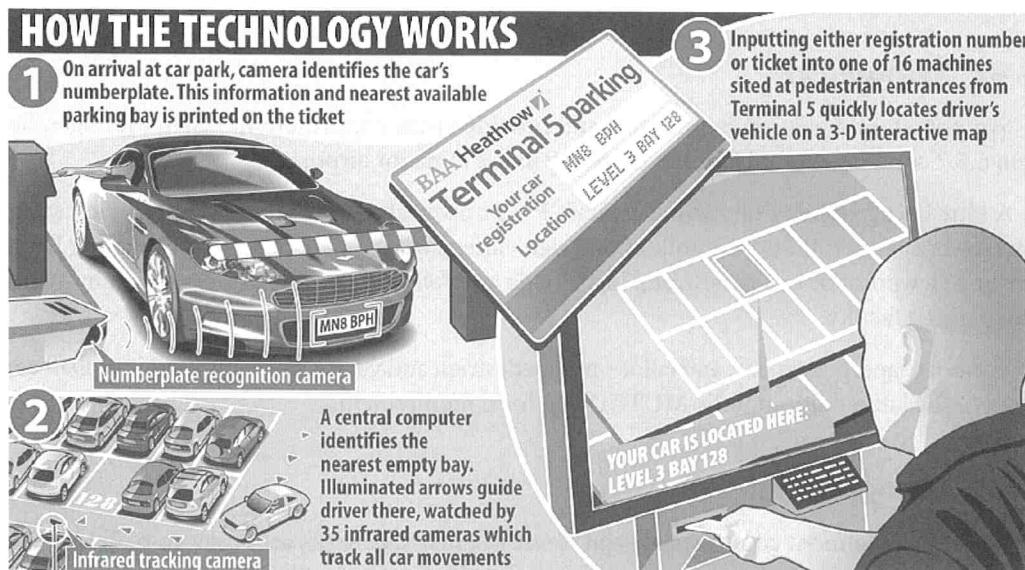


Figure 4.20. An explanation as to how technology is used to aid patrons in finding available parking and locating their vehicles at a later time.

parking spaces, entry plazas, and exit plazas to the extent possible parking facilities as a whole should follow the MUTCD. (Note: there is a MUTCD task force that is specifically examining parking facilities and how and when the MUTCD should be applied in these areas).

Some airports have developed their own sign standards for their respective facilities for consistency, continuity, and identity. Boston Logan, DFW, Miami, Frankfurt, and Hong Kong international airports are a few examples where airport-specific signing design standards and guides are implemented³⁰. These guidelines take into account specific location, architecture, codes, languages, demographics, etc., that apply to their airport but may not necessarily translate to other airports because of these exact considerations.

As mentioned previously, regulatory signs are typically designed to most closely resemble the guidance within the MUTCD than are other sign types within parking facilities. This may be attributed to local code requirements, but mostly because reasonable and prudent people easily recognize and quickly interpret their meaning. It is the placement and mounting of regulatory signs that are modified to meet the physical restrictions of a parking area such as ceiling heights/clearance within a parking garage.

4.4.1 Terminology

One of the more confusing aspects for drivers to airports is understanding the different parking options provided and the availability of parking within each option; especially when a single airport may provide seven or eight different parking choices. Terminology describing these options is not universal and adds to the confusion. See Section 4.2.2 for a list of recommended parking terminology. The following is a list of some of the wording used to describe parking areas at airports:

- Daily Parking vs. Long Term Parking
- Hourly Parking vs. Short Term Parking
- Economy Parking vs. Express Parking
- Cell Phone Lot vs. Park and Wait Area
- Terminal Parking vs. Remote Parking
- Garage Parking vs. Surface Parking
- Valet Parking vs. VIP Parking vs. Concierge Parking

4.4.2 Symbology

Symbols should be used to reinforce and provide visual confirmation of sign messages. Section 6.5.2 contains symbol families currently in use at major airports.

A blue background with a white capital “P” is universally understood as a sign indicating a parking area even if the appearance of that sign varies slightly (see Figure 4.21). Whether from a driver’s viewpoint or as a pedestrian, identifying and following these signs directs an individual to a parking facility.

Symbol shape, placement, and color on all pedestrian and vehicular regulatory signs shall conform to the latest edition of the MUTCD and local requirements.

4.4.3 Typography

While the argument continues to rage about whether sans serifs are easier to read than serif fonts, the sans serif typefaces, because their letter shapes are simpler, have been proven to be slightly more legible than their serifed cousins. Reference Section 6.5.3 for additional information on typography.



Figure 4.21. *Forms of the customary parking sign.*

For wayfinding messages, text using upper and lowercase letters with initial caps is easier to read than all uppercase lettering.

4.4.4 Arrows

The placement of arrows on sign faces should conform to a uniform standard. The following guidelines are suggested for the placement of arrows:

General Arrow Placement:

- Arrows should never point into text
- Left-facing arrows should be located toward the left side of signs
- Right-facing arrows should be located toward the right side of signs
- Forward-facing and/or downward-facing arrows are typically located close to the flow of traffic. Refer to previous discussion on which direction arrows should face for vehicle traffic versus pedestrian traffic.

General Text Alignment with Arrows:

- Left-facing arrows require left justified text
- Right-facing arrows require right justified text
- Forward-facing and/or downward-facing arrows require text to be justified closest to the flow of traffic (e.g., if forward traffic is hugging the right side of a corridor, the arrow should be on the right side of the face with the text justified right, and vice versa).

Reference Section 6.5.4 for additional information on arrows.

4.4.5 Color

In order to maintain a visually unified system of signs airport-wide, the application of color must be consistent on every element of all signing. The guidance for colors within the MUTCD

should be used as a starting point; final selection should be based on what colors create the best contrast for text and background colors. Select colors that will read well in all lighting conditions.

4.5 Sign Locations, Structures, Materials, and Safety

4.5.1 Sign Locations

With the exception of roadway and terminal signing, more guidance is available for signing in parking garages than for other areas at airports. Guidance in such documents includes placement of signs, types of signs, signs for pedestrians versus vehicles, and informational needs for various location with the parking facility^{31,32}. Because every parking facility has a unique location, architecture, configuration, and geometry, it is difficult to prepare generic parking signing plans and recommendations.

4.5.2 Illumination Options

Because the ambient light levels along roadways in most major airports can vary (from terminal buildings, roadways, and landscaping) it may be necessary to use external or internal illumination to provide adequate nighttime visibility for parking signs so that they compete equally. At smaller airports or on the outlying areas of larger airports, with lower ambient light levels, high quality retroreflective materials may provide adequate visibilities. Nighttime testing on-site will be required to make these determinations.

4.5.2.1 Retroreflection

Retroreflective sign sheeting materials return light from vehicle headlamps to the driver's eyes. Retroreflection is achieved either through microscopic glass beads with a thin metallic backing or through microprisms in a thin polycarbonate film. These materials vary in the daytime color appearance and in their nighttime brightness and efficiency with which they reflect the vehicle headlamps.

In some airports, the geometry of a parking facility is such that considerable care must be taken by the designer in sign location and orientation to ensure that vehicle headlamps will adequately illuminate the sign along the necessary driving sections. In order to get the maximum benefit from retroreflective sheeting in a garage, the sign panels should be angled towards the driver (typically 5 to 8 degrees).

The use of high quality retroreflective sheeting in place of external illumination may also help airports reduce electricity and maintenance costs and reach sustainability goals.

4.5.2.2 External Illumination (Ambient Light)

External illumination of parking signs within a parking garage can often be achieved through the ambient garage lighting. If ambient light is used, ensure the signs are located near existing light sources as much as possible. If additional lighting is needed for signing, it is recommended that internally illuminated signs be chosen over externally illuminated signs in the garage environments. This is to reduce the amount of electrical infrastructure required to support external illumination and to eliminate head clearance issues when ceiling heights are already reduced.

4.5.2.3 Internal Illumination

Internally illuminated signs can be designed to provide sign recognition and legibility distances comparable to those of externally illuminated. Proper materials and design must be used for the specific viewing angles present for a specific sign location. Candidate sign materials should

be viewed in daylight and dusk conditions to ensure that there is adequate contrast when the sign is not lit.

4.5.3 Sign Structures

The following are the types of general sign mounting frequently found in parking facilities:

- **Overhead Suspended**—signs that are suspended from the ceiling using a cable or break-away fastening system. Check wind load requirements.
- **Soffit Mount**—signs that are located on an architectural soffit or wall, and mounted with the back of the sign to the soffit or wall using a mechanical fastening system.
- **Ceiling Mount**—signs that are located flush to the ceiling and mounted with the top of the sign to the ceiling using a mechanical fastening system.
- **Flag Mount**—signs that are mounted perpendicular to the attachment surface, usually on a wall and/or soffit, and attached using a mechanical fastening system.
- **Post Mount**—signs that are mounted directionally to a ground-mounted single or double post structure using a mechanical fastening system.
- **Wall Mount**—signs that are mounted with the back of the sign to the wall using a mechanical fastening system.
- **Freestanding**—signs that have their bases mounted directly to the ground/finished floor using a mechanical fastening system.
- **Light Pole Mount**—signs that are mounted directly on the existing light pole structure.
- **Overhead Roadway**—signs that are mounted directly above the lane of traffic to a ground-mounted structure using a mechanical fastening system.

Appendix B contains detailed graphics illustrations with recommended clearances for various sign types and locations.

4.5.4 Pedestrian Safety Considerations

Specific research to analyze pedestrian and vehicle interactions within parking areas at airports has not been compiled, but research has been conducted to analyze and make safety recommendations for pedestrians at locations with high volumes of vehicles and/or pedestrians at other locations³³. Once an engineering study is completed, recommended treatments for safety improvements can be determined. These treatments fall into one of the four categories described in Figure 4.22.

Treatment Category	Description
Crosswalk	This category encompasses standard crosswalk markings and pedestrian crossing signs, as opposed to unmarked crossings.
Enhanced	This category includes those devices that enhance the visibility of the crossing location and pedestrians waiting to cross. Warning signs, markings, or beacons in this category are present or active at the crossing location at all times.
Active	Also called “active when present,” this category includes those devices designed to display a warning only when pedestrians are present or crossing the street.
Red	This category includes those devices that display a circular red indication (signal or beacon) to motorists at the pedestrian location.

Figure 4.22. Table of possible treatments to enhance pedestrian safety.

4.6 Sign Maintenance

One of the myths of wayfinding is that once a new wayfinding system is implemented the work is done. This is a false assumption. Airports are dynamic environments that are constantly changing. In order to perpetuate the integrity of the wayfinding program a systematic maintenance program must be implemented as an integral part of standard airport operations.

A strategic maintenance program is the key to perpetuating a well-planned wayfinding program. Standard procedures should be in place to address the impact of changes to airport operations, including clear update policies and scheduled maintenance reviews (quarterly, semi-annually and annually). Clearly defined procedures will help address issues such as the following:

- Addition of a new parking facility,
- Re-designation or re-configuring a parking facility,
- Adding signs,
- Deleting signs,
- Temporary signs, and
- Directories, both electronic and static.

Developing a quality Sign Standards Manual will be one of the best tools in managing consistent planning, design, installation, application, and maintenance of the sign system.

As a minimum, the following represents a suggested sign maintenance procedure:

- Monthly visual inspections: check for burned out bulbs/lights, scratched sign cabinets, sign face damage, graffiti, structural damage, and non-standard signing due to signing updates.
- Quarterly sign cleaning: cleaning of exterior surfaces and support structures. Twice a year the interior of sign boxes/cabinets should be examined for build-up of dirt, dust, and other debris.
- Replacement parts: items such as extra bulbs, hardware, and mechanical fasteners should be on hand to provide quick fixes until complete repairs can be made if needed.
- Replacement and recycling/disposal procedures: determine how damaged or obsolete signs will be removed and where the unusable items will be discarded.
- Sign maintenance manual: a maintenance manual should be prepared for in-house information but can also be distributed to sign vendors to be aware of the airport's expectations for new signs.

4.7 Accessibility

Airports are among the most difficult wayfinding environments for people with disabilities due to the multiple layers of complexity. Airport sign managers and design firms advise that airports utilize the following approaches to ensure that the environment can remain at a high standard of accessibility:

- Develop an accessibility plan and audit: During the wayfinding design and development process, it is important to have a separate audit that just focuses on accessibility issues.
- Have clear ongoing accessibility guidelines: After a project is complete these guidelines will serve as both instruction and training for airport employees and guidance for system maintenance and replacement.
- Develop an in-house expertise: Large airports should have one person responsible for managing accessibility issues while small and medium size airports should have specific departmental responsibilities for accessibility.

- Develop a resources list: This list of designers, code officials, organizations, and internal stakeholders can provide guidance on key issues and conflicts.

4.7.1 Audit of Elements

On an airport wayfinding project, it is important to develop an audit of elements that must be followed to make the facility accessible. The audit consists of two parts: Strategy and Documentation.

4.7.1.1 Strategy

All accessibility strategies should consist of the following parts:

Managing Compliance—Utilize International, National, and State codes by doing the following:

- Utilize the International Building Code for projects outside the United States. This will correspond with the current ADA.
- List the top ADA national standards being followed at the state level regarding font, placement, and color.
- List ADA issues specific to the state that may diverge from national standards.
- List the provisions in the Air Carriers Access Act.

Managing Legibility—Develop a legibility plan consisting of the following elements:

- Font height based on distance in the facility.
- Color contrast and lighting contrast requirements.
- An approach to sign clutter.
- Symbol height based on distance and number of symbols being used.

Managing the Experience—Develop a narrative of the wayfinding experience by doing the following:

- Write an accessibility narrative starting at the curb, and progressing to the gate describing the specific issues and recommendations for each area in the wayfinding process.
- Develop a series of recommendations based on the needs of the sensory impaired and mobility impaired.

Specifying Methodologies and Technologies—Specify materials by doing the following:

- Name the specific modular system (if one is used) and accessibility issues associated with that system.
- Specify materials, the material approach, vendors/manufacturers (if necessary), and paint or additional materials being applied.
- Directories and maps.
- Human assistance.
- Talking signs.
- Tactile floor surfaces.

4.7.1.2 Documentation

All accessibility documents for tactile signs for the visually impaired should consist of the following parts:

Sign Placement:

- Distance of the sign from doors and entrances and
- Height of perpendicular wall signs and overhead signs from the floor.

Sign Dimensions:

- Separation of fonts from Braille,
- Separation of font and Braille from the edge of the sign, and
- Distance of the top and bottom of the font from floor.

Fonts:

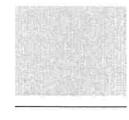
- Style,
- Height, and
- Kerning.

Sign substrate and base material:

- Specify Braille and distance of the Braille from the floor,
- Ensure all screws are flush if close to raised type,
- Show edging or rounding of materials, and
- Show material and substrate thickness.

Paint specification:

- Specify foreground and background color of materials and
- Specify matte finishing.



CHAPTER 5

Curbside and Ground Transportation

Although signing cannot overcome physical limitations and geometric difficulties, signing at and along the terminal curbside can boost the efficiency and safety of the space. The terminal curbside and ground transportation areas can be some of the most diverse and complex areas at an airport. Airports need to examine identification, regulatory, and information signing as a whole and consider the philosophy that less signing may be more useful to patrons at the curbside where so much activity is already taking place.

This chapter describes signing suggestions for the curbside/ground transportation areas while maintaining an overall design cohesion across the entire airport. The signing discussed is all exterior directions, identification, and informational signs for public use at the following locations:

- Curbside (Departures and Arrivals)
- Ground Transportation Curbsides

5.1 Planning for Curbside Signing

A comprehensive signing program for terminal curbside areas begins the moment a person approaches terminal and continues past the terminal area. The primary objective of the curbside/ground transportation sign system is to direct the flow of vehicles and pedestrian traffic to and from the curbsides. To provide an overview of the elements to consider when planning curbside and ground transportation signing, Figure 5.1 presents a checklist to consider when planning curbside and ground transportation signing.

5.2 Considering Curbside Users in Design (Human Factors)

There are two primary factors that impact curbside operations:

- The number and types of users, e.g., vehicle types, and
- The dwell times associated with each of these groups³⁴.

Figure 5.2 lists the typical users and associated vehicle types found along the terminal curbside.

How the space along the curbside is used is highly dependent on the configuration of the terminal access roadways. Depending if arriving and departing activities are separated laterally or vertically, the amount of signing and placement of signs may be handled differently. Figure 5.3 provides an example of how public and ground transportation services are physically separated by islands for pedestrian safety and distinction of various activity areas.

Area	Items
Departures Drop-off-Check-In (Vehicular)	Terminal identification Distinction of commercial lanes for public traffic and lanes for ground transportation traffic Identification of "drop-off" lanes and "through traffic" lanes Airline identification No stopping/standing areas Re-circulating directions to parking, other terminals, and airport exit Traffic control
Departures Drop-off/Check-In (Pedestrian)	Terminal verification Airline identification Door number/identification Informational signs No smoking Security requirements Emergency call boxes/telephones Crosswalks
Arrivals Pick-up (Vehicular)	Terminal identification Distinction of commercial lanes for public traffic and lanes for ground transportation traffic Identification of "pick-up" lanes and "through traffic" lanes Accessible passenger loading zones Exit door/zone identification No stopping/standing areas Re-circulating directions to parking, other terminals, and airport exit Traffic control
Arrivals Pick-up (Pedestrian)	Terminal verification Door number/identification Distinction of lanes/zones for public pick-up and commercial lanes/zones for ground transportation Informational signs No smoking Security requirements Emergency call boxes/telephones Crosswalks
Ground Transportation	Distinction of lanes for public traffic and lanes for ground transportation traffic Identification of "pick-up" lanes and "through traffic" lanes Identification of zones for various vehicle types: <ul style="list-style-type: none"> • Taxis • Rental Car Shuttles • Hotel Shuttles • Limos/Towncars • Parking Shuttles • Other service vehicles Exit door/zone identification No stopping/standing areas Crosswalks

Figure 5.1. Curbside signage checklist.

User Groups	Vehicle Types
Private Vehicle Operations	Passenger cars, trucks, and SUVs
Taxicab Operations	Passenger cars and minivans
Scheduled Services	Buses and vans
Non-scheduled Limo and Charter Bus Operations	Buses, limousines, town cars
Courtesy Vehicle Operations/Shuttles	Buses and vans associated with hotels, parking facilities, rental cars, etc.
Commercial Operations	Armored vehicles, local delivery trucks
Emergency/Enforcement Operations	Police cars, ambulances, fire trucks

Figure 5.2. Curbside users and associated vehicle types.



Photo credit: Chris Cunningham.

Figure 5.3. The use of raised islands and curbs separates vehicular and pedestrian activities on the arrivals curbside for efficiency and pedestrian safety (Richmond International Airport).

5.3 Signing Areas

Airport terminals with a single-level curbside will typically assign designated ticketing and baggage claim areas along the curb for passenger drop-off and pick-up. In North America, the terms “departures” and “arrivals” are commonly used to differentiate the primary functions along the curbside. In some instances, the terms “Passenger Drop-Off” and “Passenger Pick-Up” are used to designate the different functions but this is more common terminology at smaller airports with a single-level terminal. It is best to use the more universal terms “Arrivals” and “Departures.”

Terminology for other items is often influenced by operational decisions and physical factors. For example, areas used by courtesy vehicles operations may be combined into a category called “Shuttles”; however, these may be broken out into “Hotel Shuttles,” “Rental Car Shuttles,” and “Airport Shuttles” at another airport. The term “Shuttles” or “Ground Transportation” should be used to guide patrons *to* the general area of ground transportation vehicles, and then more specific functions can be called out (e.g., “Hotel Shuttles” and “Rental Car Shuttles”) once the person has arrived *at* the ground transportation area.

5.3.1 Departures

5.3.1.1 Terminal Identification

At airports with larger facilities, how the terminals and access roads are designed plays a significant part as to what signing becomes necessary. For departures, identifying terminals and airlines are the most important bits of information. At airports with multiple terminals, the designation of the terminal is often placed on the building itself as in Figure 5.4. The terminal designation should also be repeated along the curbside to reassure drivers they are at the proper location. An example of this type of information reinforcement is shown in Figure 5.5. Regardless of the situation, having appropriate roadway signing with re-enforcing curbside signing will help direct users to the appropriate areas.

5.3.1.2 Airline Identification

For airports with multiple airlines across multiple terminals, signs on the airport access roadways already provide information to help direct users to the right location for departures. As



Figure 5.4. Terminal designation placed on the structure.

drivers approach the terminal curbside, additional signing should be provided to assist patrons to locate the air carrier of their choice. These signs are typically static and use the airline's name to designate their location. In some instances, the air carrier's logo is also used to visually reinforce the message but is secondary information and can be displayed only if the logo does not otherwise cause the airline's name to be truncated, have reduced letter height, or condensed letter spacing just to accommodate the logo. Figure 5.6 shows one installation where the airline identifier signs are placed in a highly visible manner for vehicles and pedestrians. The text of the signs is sufficiently sized to maximize legibility from a greater distance.

The airline name as presented on roadway signing should be used on the airline identification sign. For example, if "Continental Airlines" is present on the roadway signs then the same should be placed on the airline identification sign. In some instances, the airline identification sign may be shortened to "Continental" if geometric and/or architectural considerations make necessary. It is not advised to abbreviate the airline name to "Cont.," "Cont'l.," or some other variation. Code share airlines may be listed together if the ticketing desks inside the terminal are adjacent to one another; otherwise, list the airlines separately. It is best practice to define an airline naming convention that will be used throughout the airport complex and be consistent with that policy. Although airline identification at the curbside is mostly static, some airports and airlines are using different types of technology to provide this information. Changeable message signs by the entrances to the terminal are now beginning to be used to indicate what airlines are located where. Both changeable message signs and static signs may be larger than typical directional signs to allow increased text size for visibility from a greater distance. A minimum text height of 8" letter for airline names should be practiced. The minimum letter height permitted by the MUTCD



Figure 5.5. Using terminal designations on other curbside signage to reinforce terminal identification.



Figure 5.6. Example of airline identifier signs with multiple carriers per sign (SeaTac International Airport).

is 6-inch tall text for post-mounted static signs in environments at or below 40 mph as shown in Table 2D-2 in the 2009 MUTCD⁸. For dynamic message signs, a 12-inch text height is specified in Section 2L.04 of the MUTCD⁸. Further details on the signs and design elements are provided in Section 6.5.

Airline identity signs should be located near or above the doors or entrance into the buildings. The airline(s) listed above the entry should correspond with the location of the check-in counters located nearest the door inside the building. The identification signs should be mounted perpendicular to the terminal building and the roadway. The airline names should be placed on both sides of the sign for several reasons:

- A vehicle may pull up to the curb past the location of their airline and the disembarking passenger needs to be able to look back and identify their airline.
- Pedestrians may be walking to the terminal from a parking garage or the ground transportation drop-off areas that require them to approach the terminal from a direction that is opposite the direction of traffic.



Figure 5.7. Basic curbside baggage check-in.

5.3.1.3 Flight Information

FIDs are not widely used along the curbside. For one reason, airports do not want unnecessary congestion on the sidewalks caused by people standing around with their baggage looking for their flight on a monitor. FIDs are more commonly used where there is space and time for people to examine flight information such as terminals, parking facilities, rental car centers, and transit stations. In addition, the weather in some locales makes it problematic to operate and maintain certain technologies in an outdoor environment.

5.3.1.4 Curbside Check-In

Curbside baggage check-in is a traditional service many airlines provide at various airports. These areas are staffed by airline employees and typically only handle passengers with larger or multiple pieces of luggage that cannot be carried onto the airplane. Curbside baggage check-in can be a simple counter as shown in Figure 5.7 or a larger, more permanent area with a greater amount of signing as shown in Figure 5.8.

When baggage check-in is provided along the departures curbside, additional signing must be provided. This signing is typically regulatory and informational such as the following:

- Security advisories and instructions,
- Municipal/federal regulations, and
- Airline baggage policies.



Figure 5.8. Permanent curbside baggage check-in at a larger airport.

5.3.2 Arrivals

Signing within the terminal is critical to directing arriving passengers to the appropriate area. Along the roadway and curbside, the signing should be clear enough to facilitate the desired operations. At some airports, separating the “public” traffic from “other ground transportation” is accomplished by placing the activities on opposite sides of the terminals. Some airports have their curbsides laterally separated with island medians that serve as the separation between public passenger pick-up and other ground transportation activities.

One consideration should be made in regards to terminology at airport arrivals. From the dis-embarking passengers’ perspective within the terminal, they are most likely being directed to “Baggage Claim” and/or “Ground Transportation.” From the drivers’ perspective attempting to rendezvous with their party, they are commonly seeing signs indicating “Arrivals” or “Passenger Pick-Up.” This apparent disconnect in terminology can cause confusion and frustration as both parties attempt to describe the same location using different names based on their perspective. Airports must be consistent with their terminology.

To address this issue of conflicting wording, it is recommended that the doors on the arrivals be labeled in a logical sequence, being it as simple as “Arrival Door 1” or more descriptive if the airport requires it such as “North Arrival Door 1.” For airports with multiple terminals or split curbsides, the designator should include a reference to the terminal plus the unique entrance. When a passenger is calling to coordinate with the driver picking them up, it is very easy to provide a unique location to meet. Figure 5.9 and Figure 5.10 illustrate the use of naming exit doors for easy identification.

5.4 Ground Transportation

Knowing where to locate and how much curbside space to allocate for each type of commercial vehicle usage depends on two factors: (1) the volume of vehicles for each use, and (2) the dwell times required for the associated activities. Since each airport is unique in these characteristics and even with direct airport operational experience, a specific curb allocation study should be conducted to determine commercial curbside allocations. By conducting such a curbside study, both operations and signing can be better planned and implemented in a cohesive manner that reduces confusion of patrons and improves efficiencies of the curbside.



Figure 5.9. View from curbside on the arrivals level of Hartsfield-Jackson Atlanta International Airport.



Figure 5.10. View from inside the terminal going to the arrivals level of Hartsfield-Jackson Atlanta International Airport.

With that said, signing directing arriving passengers to the correct functions along the curbside begins inside the terminal. A typical list of services includes:

- Car rental shuttle,
- Parking lot shuttle,
- Hotel shuttle,
- Public transportation,
- Transit options, and
- Taxi.

If this list of services shares a common curbside, then the umbrella term of “ground transportation” can be used to guide arriving passengers to the curbside. However, there are many airports where these services do not share a common curbside. In these instances, the directional signs inside the terminal will need to break the information down as necessary to meet the specific needs. Rental cars are a common example where passengers might go to the end of the terminal instead of the curbside.

5.4.1 Passengers Arriving/Departing at the Airport

Departing passengers should be provided with information directing them from the transit stop or station to the correct terminal and airline. Information aids for departing passengers approaching the airport should include the following:

- Sign(s) on/near the curbside that are visible from inside the transit vehicle indicating the disembarking point for the airport, or for specific terminals/airlines if more than one transit stop is made at the airport. (The same information should be repeated via an audio message for reinforcement and for ADA compliance.)
- Sign(s) and maps that are inside the transit vehicle to identify stops and airline information if more than one transit stop is made at the airport. (The same information should be repeated via an audio message for reinforcement and for ADA compliance.)

- Directional signs to guide passengers from the transit stop to the correct terminal and airline check-in counter.

Passengers who are deplaning should be provided with information for reaching and using public transportation services available at the airport. Information aids should progress from the general (“Ground Transportation”) to the more specific (“Light rail/city bus/hotel shuttles”) at successive decision points through the terminal. The following is a sample progression of information aids, beginning at the arrival gate:

- Sign(s) directing passengers from arrival gates and baggage claim areas toward Ground Transportation services.
- Information aids (wall-mounted signs, printed material, kiosks, or other format) to assist in planning the transit trip from the airport to the traveler’s final destination. These should be located at points in the terminal where passengers will make their decisions about ground transportation options. Passengers should be able to determine the following:
 - Destinations that can be reached from the airport using transit services.
 - Routes (if more than one serves the airport) that serve particular destinations.
 - Schedules/departure times.
 - Fares and purchasing options.
- Sign(s) directing passengers to specific Ground Transportation services (local bus or rail system, hotel shuttles, taxis). If the transit service requires fare media that must be purchased prior to arriving at the transit stop/station, directional signs should route passengers accordingly.
- Sign(s) directing passengers to the transit stop/station for the desired route, if there is more than one transit stop/station at the airport.
- Sign/display at transit stop/station indicating the route(s) served and departure times.
- Sign/display on transit vehicle identifying the route.

5.4.2 External Rail Systems vs. Internal

Public transit services that connect with the airport should be treated as one category of Ground Transportation service.

At airports that have an internal transit system (for instance, a bus or train connecting terminals), signs and other information aids must clearly distinguish the internal transportation system located on the landside from ground transportation services that leave the airport. Signs should list more than the brand names/logos of the airport’s internal transportation system and/or the local public transit system. Guide signs should specify whether, for instance, the “Airport Connector” is an inter-terminal people mover versus a local bus or rail route that leaves the airport. More discussion of transit means internal to an airport can be found in Section 6.3.2.

5.4.3 Technology

Interactive trip planning systems and real-time information about transit services are among the technologies that can enhance transit information services at airports.

Interactive transit information kiosks can provide an alternative to static transit schedule information and may also be part of a fare purchase system. Kiosks may be linked via the Internet to the local transit information system, or may be a self-contained transit planning system.

Real-time bus or train arrival information can supplement or replace static signs showing bus or train schedules. Real-time arrival information at transit stops has been shown to make riders feel more confident, particularly at night, and improve riders’ overall perception of the quality of transit service provided⁵⁵. If the transit stop is a long distance from the terminal and/or from other airport services, signs with real-time arrival information for the transit system should be provided in the terminal well ahead of the transit stop itself.

5.4.4 Accessibility

Transit-related signs must conform to the same visibility/legibility requirements as other curbside or in-terminal signs and displays. Where possible, information aids for wayfinding, transit trip planning, and real-time bus/train arrival should provide information both visually and aurally.

Information kiosks or computer stations should conform to the Federal Government's Section 508 standards for accessibility.

5.5 Sign Design Elements

Although the MUTCD is a recognized standard and guide for roadway signing, airports can generally make their own decisions when it comes to signing along terminal curbsides. Some airports have developed their own sign standards for their respective facilities for consistency, continuity, and identity. Boston Logan, DFW, Miami, Frankfurt, and Hong Kong international airports are a few examples where airport-specific signing design standards and guides are implemented³⁵. These guidelines take into account specific location, architecture, codes, languages, demographics, etc., that apply to their airport but may not necessarily translate to other airports because of these exact considerations. Many of the same design elements used inside the terminal can be applied on the curbside area (refer to Section 6.5).

As mentioned previously, regulatory signs are typically designed to most closely resemble the guidance within the MUTCD than are other sign types along the curbside. This may be attributed to local code requirements, but mostly because reasonable and prudent people easily recognize and quickly interpret their meaning. It is the placement and mounting of regulatory signs that are modified to meet the physical restrictions of a curbside area such as awnings, canopies, columns, and other structural and/or architectural elements.

5.5.1 Terminology

Airports come in many sizes and various configurations. While one airport may have a single terminal on one level, another may have multiple terminals with two or three levels. These differences impact how airport managers designate where people access different functions. For smaller terminals on a single level, using the terminology of "Ticketing" or "Passenger Check-In" may be sufficient to distinguish from "Baggage Claim" along the curbside. The terms "Arrivals" and "Departures" are more widely encountered at larger airports with a split curbside and are just as valid at smaller airports.

At airports with larger facilities, how the terminals and access roads are designed plays a significant part as to what signing becomes necessary. For departures, identifying terminals and airlines are the most important bits of information. In North America, the terms "arrivals" and "departures" are commonly used to differentiate the primary functions along the curbside. In some instances, the terms "Passenger Drop-Off" and "Passenger Pick-Up" are used to designate the different functions, but it is advised to use the more universal terms of "arrivals" and "departures."

Terminology for other items is often influenced by operational decisions and factors. For example, areas used by courtesy vehicles operations may be combined into a category called "Shuttles"; however, these may be broken out into "Hotel Shuttles," "Rental Car Shuttles," and "Airport Shuttles" at another airport. The term "Shuttles" or "Ground Transportation" should be used to guide patrons to the general area of ground transportation vehicles, and then more specific functions can be called out (e.g., "Hotel Shuttles" and "Rental Car Shuttles") once the person has arrived at the ground transportation area.

5.5.2 Symbology

As commercial aviation has expanded the ability for people to travel virtually anywhere around the world, the need for airports to communicate with individuals from various nations, speaking different languages, has also grown. Symbols can overcome the need to reproduce directions and information in multiple languages.

Symbols should be used to reinforce and provide visual confirmation of sign messages. The 2001 Guide³⁶ does provide, however, a visual inventory of the most widely accepted symbol standards in current use. In addition, Section 6.5.2 contains symbol families currently in use at major airports.

The 2001 Guide³⁶ provides examples of acceptable symbols for various functions and designations. The United States Department of Transportation (USDOT) also compiled a reference of symbol signs that are considered internationally acceptable³⁷. As airport users see a standard set of symbols deployed across airports, people begin to identify them through the repetition and eventually seek them out for assistance and guidance.

5.5.3 Typography

While the argument continues about whether sans serifs are easier to read than serif fonts in text copy, sans serif typefaces, because their letter shapes are simpler, have been proven to be slightly more legible than their serifed cousins. Although the MUTCD can be a starting point for font and text size, the geometry and configuration of the curbside may require deviation from the MUTCD.

On the departures level, the most important information patrons need to recognize is the terminal identification and the airline identifications. It is recommended that minimum text height of 8 inches be used if possible. This letter height may influence if a static sign must be used or if enough clearance is provided so that an internally illuminated sign box can be provided. See Section 6.5.3 for additional information.

5.5.4 Arrows

The placement of arrows on sign faces should conform to a uniform standard. The following guidelines are suggested for the placement of arrows:

General Arrow Placement:

- Arrows should never point into text.
- Left-facing arrows should be located toward the left side of signs.
- Right-facing arrows should be located toward the right side of signs.
- Forward-facing and/or downward-facing arrows are typically located close to the flow of traffic. Refer to the previous discussion regarding which direction arrows should face for vehicle traffic versus pedestrian traffic.

General Text Alignment with Arrows:

- Left-facing arrows require left justified text.
- Right-facing arrows require right justified text.
- Forward-facing and/or downward-facing arrows require text to be justified closest to the flow of traffic (e.g., if forward traffic is hugging the right side of a corridor, the arrow should be on the right side of the face with the text justified right, and vice versa).

See Section 6.5.4 for additional information on arrows.

5.5.5 Color

In order to maintain a visually unified system of signs airport-wide, the application of color must be consistent on every element of all signing. Care should be taken, however, to avoid contradiction with standard colors for regulatory signs. Green stop signs and blue no parking signs are not immediately recognized. The MUTCD shall be referenced for colors on regulatory signs.

In other situations, colors should be distinct enough to reinforce the idea of different items. For example, using “orange” to identify Terminal A and “purple” to designate Terminal B is easily recognizable by a large portion of the population. The difference between “teal” and “turquoise” may be indistinguishable. Reference Section 6.5.5 for additional information on color.

5.6 Sign Locations, Structures, Materials, and Safety

5.6.1 Sign Locations

Because every terminal and associated curbside has a unique location, architecture, configuration, and geometry, it is difficult to prepare generic signing plans and recommendations. Viewer circulation patterns and natural lines of vision are the basis for determining the location of all signs. Signs shall be located to precede decision points to ensure sufficient time for people to react to each sign message.

Signs for vehicular traffic should typically be placed perpendicular to the path of travel. Signs focused on pedestrian needs should typically be separated visually from the vehicular signs. Signs that are for the benefit of pedestrians can be suspended from canopies/awnings or mounted from the terminal building itself. The idea is to place pedestrian signing in the location where only pedestrians will be circulating.

5.6.1.1 Sign Frequency and Avoidance of Sign Clutter

Directional signing should be located at decisions points and used as confirmational signs if appropriate. In some cases, the frequency in which a sign must be placed is dictated by local ordinance. Such signs may include “no parking” and “no loitering.”

Identification signs should only be placed at or near the actual location of the place that is being referenced. The concept of “less may be more” is very true regarding signs along the curbside. It can be a temptation to use signing to quickly address an issue (or complaint) without considering the impact to the overall signing scheme. Signing should be used primarily to direct traffic/pedestrians and identify items along the curbside. Signing prior to decision points is necessary and the identification of terminals and airlines is paramount. In addition, certain regulatory signs are required by various laws and ordinances. Airport sign managers should layout the placement of signs to accommodate those functions first. The need for secondary signing can then be considered and added if it does not deteriorate the purpose of the primary messages.

It is very tempting for airports to place—or permit others to place—advertisement along curbsides as a way to generate revenue. It is highly recommended that signage not be placed on the curbside that does not relate to the function of the curbside. There is too much activity along the curbside where distractions to drivers and pedestrians should be kept to a minimum. Marketing and advertisement signage may be placed within the terminals, elevator lobbies, and other locations that are consistent with this guide book.

5.6.2 Illumination Options for Night-Time Visibility

Because the ambient light levels along curbsides in most major airports can vary (from terminal buildings, roadways, and landscaping) it may be necessary to use external or internal illumi-

nation to provide adequate nighttime visibility for curbside and ground transportation signs so that they compete equally. At smaller airports or on the outlying areas of larger airports, with lower ambient light levels, high quality retroreflective materials may provide adequate visibilities. Nighttime testing on-site will be required to make these determinations.

The lower level(s) of curbsides that are split vertically are typically darker in both day and nighttime conditions. Therefore, to ensure adequate illumination of signing on lower level curbsides requires special consideration during the planning and design phases.

5.6.2.1 *Retroreflection*

Retroreflective sign sheeting materials return light from vehicle headlamps to the driver's eyes. Retroreflection is achieved either through microscopic glass beads with a thin metallic backing or through microprisms in a thin polycarbonate film. These materials vary in the daytime color appearance and in their nighttime brightness and efficiency with which they reflect the vehicle headlamps.

In some airports, the geometry of the curbside is such that considerable care must be taken by the designer in sign location and orientation to ensure that vehicle headlamps will adequately illuminate the sign along the necessary driving sections.

The use of high quality retroreflective sheeting in place of external illumination may also help airports reduce electricity and maintenance costs and reach sustainability goals. If this material is used, the sign panels should be angled 5–8 degrees towards the driver.

5.6.2.2 *External Illumination (Ambient Light)*

External illumination of signs along a terminal curbside may be achievable by the ambient lighting in and around the terminal. If additional lighting is needed for signing, it is recommended to use internally illuminated signs rather than externally illuminated signs in the curbside environments. This is to reduce the amount of electrical infrastructure required to support external illumination and to eliminate head clearance issues if ceiling heights are already reduced.

5.6.2.3 *Internal Illumination*

Internally illuminated signs can be designed to provide sign recognition and legibility distances comparable to those of externally illuminated. Proper materials and design must be used for the specific viewing angles present for a specific sign location. Candidate sign materials should be viewed in daylight and dusk conditions to ensure that there is adequate contrast when the sign is not lit.

With internally illuminated signs, it is important to understand that the size of the sign does not relate to the size of the text. Appropriate negative space around the text of the sign as well as the sign frame must be taken into consideration when sizing and ordering internally illuminated sign boxes.

5.6.3 **Structures and Mounting**

The following list includes the types of general sign mounting frequently found along curbsides:

- **Overhead Suspended**—typically applicable to the lower level curbside conditions, these signs are suspended from the ceiling using a cable or break-away fastening system.
- **Soffit Mount**—signs that are located on an architectural soffit or wall, and mounted with the back of the sign to the soffit or wall using a mechanical fastening system.
- **Ceiling Mount**—typically applicable to the lower level curbside conditions, these signs are located flush to the ceiling and mounted with the top of the sign to the ceiling using a mechanical fastening system.

Treatment Category	Description
Crosswalk	This category encompasses standard crosswalk markings and pedestrian crossing signs, as opposed to unmarked crossings.
Enhanced	This category includes those devices that enhance the visibility of the crossing location and pedestrians waiting to cross. Warning signs, markings, or beacons in this category are present or active at the crossing location at all times.
Active	Also called “active when present,” this category includes those devices designed to display a warning only when pedestrians are present or crossing the street.
Red	This category includes those devices that display a circular red indication (signal or beacon) to motorists at the pedestrian location.

Figure 5.11. Table of possible treatments to enhance pedestrian safety.

- **Flag Mount**—signs that are mounted perpendicular to the attachment surface, usually on a wall and/or column, and attached using a mechanical fastening system.
- **Post Mount**—signs that are mounted directionally to a ground-mounted single or double post structure using a mechanical fastening system.
- **Wall Mount**—signs that are mounted with the back of the sign to the wall using a mechanical fastening system.
- **Freestanding**—signs that have their bases mounted directly to the ground/finished floor using a mechanical fastening system.

See Appendix C for graphic illustrations with recommended clearances for various sign types and locations.

5.6.4 Safety

Specific research to analyze pedestrian and vehicle interaction along terminal curbsides at airports has not been compiled, but research has been conducted to analyze and make safety recommendations for pedestrians at locations with high volumes of vehicles and/or pedestrians at other locations³⁸. Once an engineering study is completed, recommended treatments for safety improvements can be determined. These treatments fall into one of the four categories described in Figure 5.11.

5.7 Sign Maintenance

One of the myths of wayfinding is that once a new wayfinding system is implemented the work is done. This is a false assumption. Airports are dynamic environments that are constantly changing. In order to perpetuate the integrity of the wayfinding program, a systematic maintenance program must be implemented as an integral part of standard airport operations.

A strategic maintenance program is the key to perpetuating a well-planned wayfinding program. Standard procedures should be in place to address the impact of changes to airport operations, including clear update policies and scheduled maintenance reviews (quarterly, semi-annually and annually). Clearly defined procedures will help address issues such as the following:

- Addition of a new terminal,
- Re-designation or re-configuring a terminal,
- Adding signs,
- Deleting signs, and
- Temporary signs.

Developing a quality Sign Standards Manual will be one of the best tools in managing consistent planning, design, installation, application and maintenance of the sign system.

As a minimum, the following represents a suggested sign maintenance procedure:

- Monthly visual inspections: check for burned out bulbs/lights, scratched sign cabinets, sign face damage, graffiti, structural damage, and non-standard signing due to signing updates.
- Quarterly sign cleaning: cleaning of exterior surfaces and support structures. Twice a year the interior of sign boxes/cabinets should be examined for build-up of dirt, dust, and other debris.
- Replacement parts such as extra bulbs, hardware, and mechanical fasteners should be on hand to provide quick fixes until complete repairs can be made if needed.
- Replacement and recycling/disposal procedures: determine how damaged or obsolete signs will be removed and where the unusable items will be discarded.

Sign maintenance manual: a maintenance manual should be prepared for in-house information but can also be distributed to sign vendors to be aware of the airport's expectations for new signs.

5.8 Accessibility

Airports are among the most difficult wayfinding environments for people with disabilities due to the multiple layers of complexity. Airport sign managers and design firms advise that airports utilize the following approaches to ensure that the environment can remain at a high standard of accessibility:

- Develop an accessibility plan and audit: During the wayfinding design and development process it is important to have a separate audit that just focuses on accessibility issues.
- Have clear ongoing accessibility guidelines: After a project is complete these guidelines will serve as both instruction and training for airport employees and guidance for system maintenance and replacement.
- Develop an in-house expertise: Large airports should have one person responsible for managing accessibility issues while small and medium size airports should have specific departmental responsibilities for accessibility.
- Develop a resources list: This list of designers, code officials, organizations, and internal stakeholders can provide guidance on key issues and conflicts.

5.8.1 Accessibility Audit

On an airport wayfinding project it is important to develop an audit of elements that must be followed to make the facility accessible. The audit consists of two parts: Strategy and Documentation.

5.8.1.1 Strategy

All accessibility strategies should consist of the following parts.

Managing Compliance

International, National and State codes:

- Utilize the International Building Code for projects outside the United States. This will correspond with the current ADA.
- List the top ADA national standards being followed at the state level regarding font, placement, and color.
- List ADA issues specific to the state that may diverge from national standards.
- List the provisions in the Air Carriers Access Act.

Managing Legibility

Develop a legibility plan consisting of the following elements:

- Font height based on distance in the facility.
- Color contrast and lighting contrast requirements.
- An approach to sign clutter.
- Symbol height based on distance and number of symbols being used.
- An approach for multiple languages.

Managing the Experience

Develop a narrative of the wayfinding experience:

- Write an accessibility narrative starting at the curb, and progressing to the gate describing the specific issues and recommendations for each area in the wayfinding process.
- Develop a series of recommendations based on the needs of people with sensory impairment and those with mobility impairment.

Specify Methodologies and Technologies

Materials specifications:

- Name the specific modular system (if one is used) and accessibility issues associated with that system.
- Specify materials, the material approach, vendors/manufacturers (if necessary), and paint or additional materials being applied.
- Directories and maps.
- Human assistance.
- Talking signs.
- Tactile floor surfaces.

5.8.1.2 Documentation

All accessibility documents for tactile signs for people with visual impairment should consist of the following parts.

Sign placement

- Distance of the sign from doors and entrances.
- Height of perpendicular wall signs and overhead signs from the floor.

Sign dimensions

- Separation of fonts from Braille.
- Separation of font and Braille from the edge of the sign.
- Distance of the top and bottom of the font from floor.

Fonts

- Style.
- Height.
- Kerning.

Sign substrate and base material

- Specify Braille and distance of the Braille from the floor.
- Ensure all screws are flush if close to raised type.
- Show edging or rounding of materials.
- Show material and substrate thickness.

Paint specification

- Specify foreground and background color of materials.
- Specify matte finishing.



CHAPTER 6

Terminal

6.1 Wayfinding Philosophy and Principles

An airport should be able to identify wayfinding problems and define what wayfinding success looks like. Philosophically, the goal of an airport's wayfinding system is simple: to help improve the passenger experience. Begin by developing a clear wayfinding strategy (Section 2.3). An airport that creates a positive passenger experience will create a positive impression of their airport.

A key principle of any wayfinding strategy is to value it. It is critical to think of your airport's wayfinding system as a building system; just like the HVAC system, the communication system, the electrical system, etc. All of these systems require maintenance and service in order for your airport to operate efficiently. Your wayfinding system should be treated no differently. This is a very important concept to make part of every airport's culture. In order for the airport's wayfinding to be successful it must be treated as an integral part of the airport's building systems.

To develop a wayfinding strategy, apply these key principle concepts by asking:

- Continuity—Is your wayfinding system the one common thread that provides continuity in a diverse architectural environment as your passengers navigate from one space to another?
- Connectivity—Does your wayfinding system deliver the right message at the right location at the right time?
- Consistency—Think of wayfinding as a giant exercise in packaging information that can be clearly communicated to the user. Does your wayfinding system communicate information in a consistent manner throughout the passenger journey? Consistency becomes visible to passengers through the following design elements:
 - Terminology and Message Hierarchy,
 - Visibility and Legibility,
 - Typography and Symbology,
 - Format and Color, and
 - Placement.

The wayfinding inside a terminal should not be expected to overcome architectural wayfinding barriers. Solution: Insist that every architectural project be evaluated from a passenger's wayfinding perspective and seize opportunities to correct architectural problems whenever possible.

Wayfinding information must compete with visual images such as regulatory, advertising, retail concessions, etc. Seldom is all this information implemented as a system. Solution: Develop information zones based on the airport's architecture to avoid competition.

To determine how successful an individual airport terminal building is in terms of wayfinding efficiency, it is worth considering measuring the Level of Service achieved for passengers' wayfinding experience. The Airports Council International (ACI) and other organizations conduct annual

passenger satisfaction surveys that include measures for wayfinding, or an airport can conduct their own survey.

6.1.1 Wayfinding Analysis and Checklist

The simplest and most straightforward way to analyze a wayfinding system is to physically conduct a field survey of existing conditions by walking the terminal with floor plans and camera in hand. Mark each location on the plan and key them with the photo for easy reference later (Figure 6.1).

Information Database

Keeping track of this information can quickly become an overwhelming task. Regardless of the airport size taking time to create (and maintain) a computerized database will yield a positive return on the time invested. Plan early and define what information needs to be included. Determine if this information should be part of the airport's database.

Each of the items on this checklist is centered on establishing and maintaining a consistent sign system. There are a lot of considerations that go into each of these topics and they are discussed in greater detail in other sections, but here is a quick checklist of things to look for:

Terminology—check for consistent wording in all forms of communication such as the following:

- Signs,
- Directory maps,
- Handout maps,
- Website maps, and
- Various forms of verbal communication such as those provided at Information desks.

For an example of inconsistent terminology, the following is a list taken from a field survey at one airport that found six different messages referring to the same destination:

- Train,
- Transportation,
- Train Central City,
- Train to Central City,

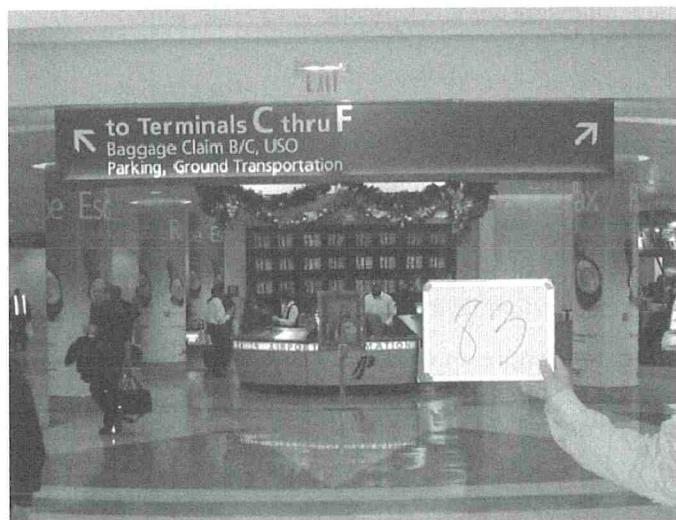


Figure 6.1. Example photo from a typical field survey.

- Train to Central City/Terminal A-E, and
- Terminals A-E/Train to Central City.

For airports that have both mass transit trains as well as an airport train this issue can become even more complex.

To resolve the inconsistency the message must be analyzed based on what is trying to be communicated. There was a reason each one of the six different messages was used and step one is understanding why. Step two is separating the key words from the unnecessary or extraneous words. Step three is looking for any other words not currently used that may help clarify the message. Step four is culling the list into words that are accurate and clearly communicate the information necessary for a passenger to make the correct choice. Step five is test the best choice(s) for comprehension. The goal is to use the fewest words possible that clearly communicate the message.

Hierarchy. Check for consistent order and placement of messages. Establishing primary messaging versus secondary messaging will help with this task. While this list will vary from one airport to another it is helpful in understanding the concept.

Typical primary messages in a terminal are:

- Ticketing/Check-in,
- Baggage Claim,
- Gates, and
- Ground Transportation.

Typical secondary messages in a terminal are:

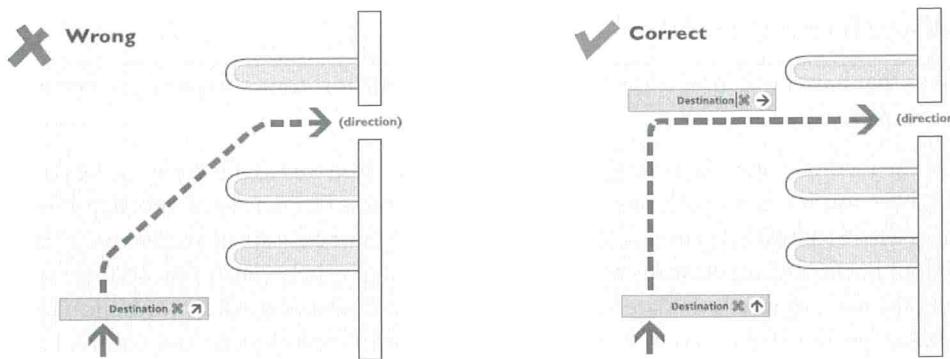
- Concessions,
- Elevators,
- Information (Desks or Directories),
- Parking, and
- Restrooms.

Hierarchy also includes prioritizing what information to list at a given decision point in the route. In other words, what is the minimum amount of information necessary to move a passenger to the next decision point? The goal is to avoid information overload. A common wayfinding myth is thinking the best way to solve a wayfinding problem is to list every possible destination, but in reality this is rarely the case. Really, the more complex the wayfinding problem, the simpler the solution needs to be. (See Section 6.5.1.1 Message Hierarchy for additional details.)

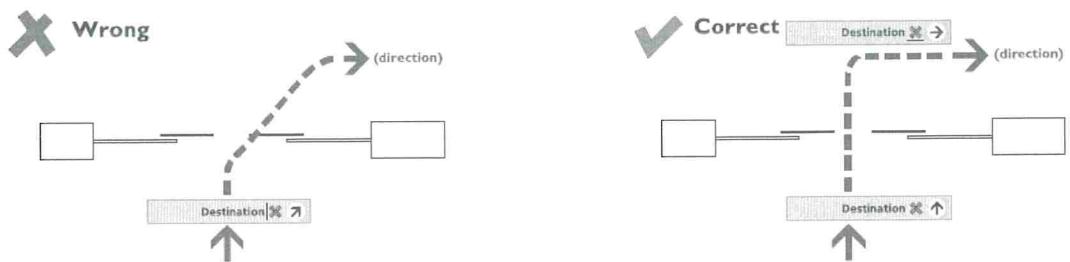
Location. The wayfinding signs must be consistently located in the right place with the right message. It is important to think about where passengers are most likely to look for the information (e.g., they will be looking for baggage claim information as soon as they deplane), and to consider decision points. In addition, it must be remembered that placement affects many things including visibility, legibility, and arrows, but ultimately it impacts a passenger making the correct decision with confidence. Figure 6.2 is a diagram that illustrates this point.

Visibility. Can you see the sign from the location passengers are most likely to look for it? Consistent sign placement is important. Same goes for lighting. Check the lighting in both day and night conditions. Another factor that impacts visibility is designating information zones so that advertising and retail signs do not encroach on the wayfinding information. While advertising and concessions do generate revenue, passengers will not feel comfortable taking time to shop or read the ads if they are lost or confused and worried about missing their flight.

Viewing angles are also an important part of visibility. Avoid exceeding a 10-degree angle from the natural line of vision, particularly in spaces with high ceilings or transition areas that involve changing levels. Check for basic conformance and note any locations that seem problematic.



Never combine two items of routing information on one sign by using a slanted arrow (45 degrees) for continuing straight ahead for a short distance and then turning. In these cases, two signs should be used; one meaning 'straight ahead' and the other, at the decision point, for a right or left direction.



A similar situation occurs when a directional sign in front of an exit directs users to a destination point that is beyond the actual exit.

Source: The Port Authority of NY & NJ Signing and Wayfinding Airport Standards Manual.

Figure 6.2. Placement affects many things, but ultimately it impacts a passenger making the correct decision with confidence. These diagrams help illustrate this point.

Legibility. There are many factors that impact sign legibility with a litany of studies, charts, and formulas for calculating distance and letter height. For the purpose of this checklist, using 40 feet of viewing distance for every inch of letter height is recommended for the vast majority of pedestrian conditions, (a 3 inch tall letter would be legible from 120 feet). (Reference Section 6.5.3 Typography for additional information about legibility.)

Format. Arrows, typography and symbology. Consistent application of the arrow, symbol, and message will help instill passenger confidence in the wayfinding. These applications should be based on a sign grid standard developed to insure proper legibility for each component. Consistently following a sign grid with pre-determined sizes for arrows, symbols, and messages will also provide major dividends when making future changes (Figure 6.3).

Frequency. What is the right number of signs? Philosophically the fewer signs the better because it helps simplify the wayfinding, reduces visual clutter, and it also helps reduce the cost of the sign system. However, a complex architectural space may require additional signs to compensate for lacking an intuitive wayfinding design. Locations that may need additional signs to account for other users include the following:

- In the concourse, not just those walking down it,
- Coming out of restrooms,
- Coming out of a concession area, and
- Especially those arriving on a flight that need confirmation of which way to go.

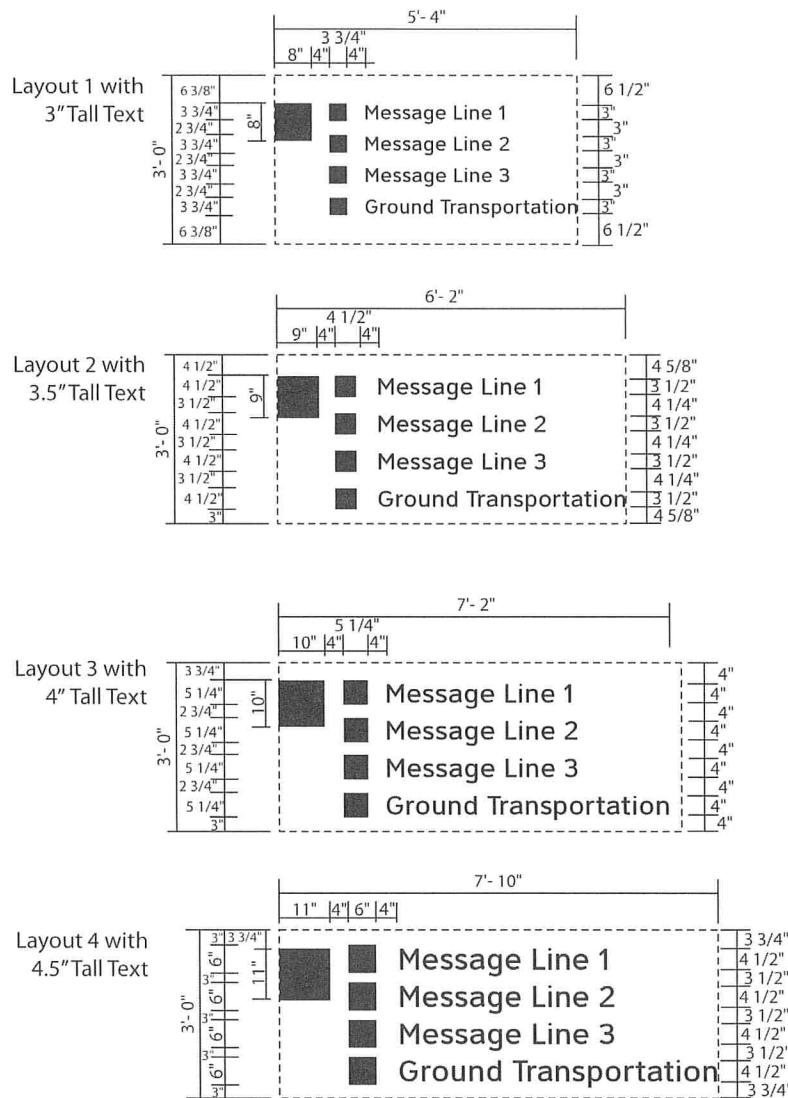


Figure 6.3. The above graphic is an example of a typical sign grid study of how different letter heights affect the overall sign grid as the size and proportions change. Note that "Ground Transportation" is used to represent the longest line length.

The goal is to be as consistent as possible and still use the same frequency because it is expected, especially for long corridors that may pass through visually busy graphic environments, then further down are not so busy. If there are no key decision points along a given route, research results indicate that signs should be added to reassure the passenger they are still on the correct path. Consider placing these reassurance signs every 150 to 250 feet³⁹.

Mounting height. The airport architecture ultimately dictates the mounting height of the overhead directional signs, so it is important to survey the varying conditions in order to determine a consistent mounting height for these sign types as well as identify exceptions such as low ceilings.

Color. If the wayfinding system incorporates color as a wayfinding device then this issue becomes critical to maintaining the integrity. When applied as part of a comprehensive wayfinding strategy color coding can be an effective tool to speed up visual search and help passengers locate the specific information they need on the sign. However, the colors used must be limited in

number and visually distinct or this advantage will be lost. Many airports that have grown over the years do not have a consistent application of color in their sign program. Even on a subconscious level inconsistent color application undermines the passenger perception of the wayfinding system and ultimately the airport itself. (Reference Section 6.5.5 on Color for additional details.)

Directory maps. Make sure every map is oriented in a “heads up” position to match the position of the viewer. Any maps that are not properly oriented should be corrected immediately.

Continuity and connectivity. In overall terms there should be an effective wayfinding strategy that establishes clear routes throughout the terminal building. Depending on the size and complexity of an airport analyzing the continuity and connectivity of the wayfinding can be a very involved process that requires time, effort and a certain level of wayfinding expertise. See Section 2.3 for details of the key concepts.

Evaluation. A number of methods can be used to evaluate a wayfinding system. Four approaches are the following:

- An ergonomic assessment in which signs representative of the entire signing system are evaluated with respect to conspicuity, legibility, information load, comprehension, and placement.
- A survey of airport staff to determine most frequently asked questions.
- A task analysis involving passengers unfamiliar with the airport who describe their experience as they attempt to navigate along the more important wayfinding chains.
- A survey of passengers selected for being unfamiliar with the airport

Ergonomic sign assessment. The ergonomic assessment would establish the major wayfinding chains and then evaluate signs along the route with respect to the qualities noted. The wayfinding chain concept is introduced in Section 2.3.3.1.

Frequently asked questions survey. When passengers experience wayfinding difficulties they are likely to ask airport staff for help. Interviews with staff can be used to identify the most common wayfinding questions in each area of the airport. Key staff (e.g., official airport volunteers) can be given a list with the most common questions (this reduces workload for staff assisting in the survey), and can tabulate the number of times they are asked various questions over a defined period. Any additional questions can be added as they are asked. Frequently asked questions will assist in identifying signing problems. Any FAQ survey must account for time of day and the actual date.

There is a wealth of knowledge passed along by the traveling public that remains unharvested because airport workers and personnel either do not know what to do with the information, do not care, or do not feel it is important enough to share. Thus, communicating and educating the personnel and daily users (such as airlines, TSA, concessionaires, etc.) would help in the feedback solicitation process. The reality is these comments that pour in come from a variety of users to a variety of personnel. Depending upon their familiarity with airport planning/design practices these comments may be assigned incorrectly (for example, many complaints at airports are wrongly-associated with airlines), so it is important to gather accurate information.

Task analysis. Major wayfinding chains would need to be established. People unfamiliar with the airport, but potential passengers, would be recruited and asked to travel to various destinations within the airport accompanied by a researcher. A verbal protocol would be used whereby each participant would voice their thoughts as they carry out the wayfinding tasks, giving the researcher insight into where and why wayfinding problems occur.

Survey of unfamiliar passengers. Unfamiliar passengers willing to fill in a survey could be recruited in the parking garage before they enter the terminal. The survey would be collected at the gate. The questions should focus on where along the journey the participant was not confident about their path or where they got lost, where they looked for and could not find specific signs, and where they had to ask someone for directions.

Recommendations. The above wayfinding evaluations will determine what corrective action(s) may be necessary. The list of corrective actions can be prioritized in one of these several ways:

- Cost—Least expensive to most expensive.
- Time—Short term solutions versus long term solutions.
- Benefit—What changes will yield the biggest improvement to minor improvement.

Resources are finite, so by using each of these criteria an airport should be able to develop an action plan that will provide the best wayfinding value for the capital dollar. If the corrections are minimal, cost may not be an issue and implementation of the changes can be expedited fairly easily. However, if the correction cost is substantial, an airport may be reluctant to make the necessary financial commitment. In this case a testing period may help.

Testing. Establishing a test area can be a very beneficial process to make any final modifications and confirm the proposed corrective actions. Virtually every airport will have different wayfinding issues. The following are suggested steps to follow:

- Select a test area that will yield a valid study.
- Establish a baseline by surveying the existing wayfinding system in the test area using one of the methods discussed above.



CASE STUDY

Port Columbus International Airport—Pilot Test Project

In 2001 Port Columbus International Airport began a test sign survey to help them evaluate proposed changes to their wayfinding system. The test period lasted two months. A passenger survey was administered by the Airport Ambassadors (volunteers) to 126 respondents over a 5-day period. When the results of the test survey were tabulated, the overall response was very positive and provided the airport the confirmation they needed to implement a \$1.8M wayfinding program for the terminal, three concourses, and parking garage.

The big question is how have the wayfinding changes impacted the passenger wayfinding experience? Since the completion of the new sign system in 2003, the ACI ASQs have shown a continued trend of improved passenger satisfaction with the wayfinding experience at Port Columbus International Airport. This is an important aspect to view these measures as part of a continuum and not just as a snapshot in time.

Keys to the success of the pilot test project:

- Simple and quick survey that measured:
 - Familiarity of the airport.
 - Legibility.
 - Comprehension.
 - Preference and effectiveness of the color coded signs versus the non-color coded signs.
- Test known problem area
 - Based on customer complaints
- Test signs were digital paper prints
 - Economical
 - Able to make changes on the fly
- Approximate cost was \$15,000, and the pilot test lasted approximately 2 months

- Develop a plan for the proposed changes and implement.
- Administer the same survey.
- Evaluate the results and make recommendations.

6.1.2 Architectural Complexity

Based on research studies and aviation industry surveys the number one factor that impacts the passenger wayfinding experience is the role of the architectural configuration.

As expected the results show that an increase in plan complexity is related to a decrease in wayfinding performance. Despite the use of signs, the plan configuration was found to exert a significant influence on wayfinding performance, because participants with access to signing in the most complex settings still made more wrong turns than those in the simplest settings with no signs. The presence of signs is not always able to compensate for wayfinding problems due to the complexity of the floor plan. However, this is exactly what a sign system in a complex airport environment is expected to do.

Therefore, it is imperative that airport planners understand the importance of wayfinding as part of the design process to create more intuitive architectural spaces where passengers know things instinctively. Conversely, wayfinding systems must account for complex architectural spaces in the planning and design process.

6.1.2.1 Linear Wayfinding

Designing open spaces that provide visual access to the destination creates the ideal linear wayfinding environment and will typically decrease the dependence on signs. Creating visual access can reduce the number of signs needed. Linear wayfinding describes exactly what it sounds like: the process of connecting point A to point B, origination to destination.

6.1.2.2 Non-Linear Wayfinding

Even without the supporting research, it is easy to acknowledge that airports can be very complex; both operationally as well as architecturally. When looking for answers to solve complex wayfinding issues, the first challenge is how to physically and visually get your mind around the problem? The answer is it has to start globally. An airport with multiple levels and buildings needs to be viewed in a manner that can tie them all together. Using diagrams like the exploded axonometric view in Figure 6.4 provides an excellent method for understanding and evaluating passenger flow. This type of planning diagram can be used to evaluate linear wayfinding scenarios as well as identify and investigate an airport's non-linear wayfinding scenarios that can be difficult to track on a single floor plan.

The identification and support of non-linear wayfinding scenarios is difficult. However, the successful resolution of the non-linear scenarios can yield some of the biggest improvements to the passenger wayfinding experience. Examples of non-linear scenarios will vary from one airport to another and are not easily documented, but the following are several examples to help understand what constitutes a non-linear wayfinding condition.

The walk versus ride for connecting flights is one of the more challenging wayfinding scenarios to communicate to passengers and requires a global analysis to reach a comprehensive solution. For example: PHL has a Shuttle Bus connection at Gates A1, C16 and F10 which sounds simple but from a passenger's perspective the connections are not actual gates. To complicate the issue there is no information provided to address the walk vs. ride option like there is at Boston Logan (see Figure 6.5).

The new McNamara Terminal in Detroit has 78 gates in one long concourse. The plan configuration simplifies the general wayfinding with an architectural space with clear visual access. Given these positive attributes, there is the physical challenge of simply walking from one end of



Linear Wayfinding

Fewings⁴⁰ refers to linear wayfinding as a sequential series of destinations. He also notes three key variables that affect the traveler's wayfinding experience:

- Visual access
- Architectural differentiation
- Plan configuration

Wayfinding indoors also follows the same intrinsic process of a series of problem solving tasks that allow the traveler to reach his or her destination. In other words, when trying to get to a destination, the traveler tends to make a decision to go to an intermediate destination, such as stairway, hallway or intersection point. Often, this may be simply to get to the end of their line of sight and to see what the next set of options may be. In a large airport terminal, some decisions are made for the traveler in that intermediate destinations have to be sequential; for example, a typical sequence would include: check-in, security, passport control and departure gate in that order. In smaller terminal buildings, the traveler can immediately see the aircraft parked on the far side of the terminal but the same intermediate 'obstacles' still have to be negotiated. Inside buildings, people use several cues or visual and spatial variables in order to find their way around. These variables include visual access, architectural differentiation and plan configuration. Internal design features also have an impact on wayfinding performance. Starting with visual access, when a person is trying to find a facility or location, or trying to get orientated within a building, it is easier to manage if there are landmarks associated with specific areas or zones. In addition, wayfinding is eased if there is direct visual access to the location that they are aiming towards; for example, as already mentioned, parked aircraft that are visible when passengers enter the terminal. Therefore, the extent to which different parts of the building can be seen from other parts of the building can have a direct effect on the ease of wayfinding within that environment.

the mile-long concourse to the other to get to your gate. The wayfinding challenge is how to communicate to a passenger if they should walk to their gate or ride the Express Tram?

The directory shown in Figure 6.6 is well organized and helps orient passengers where they are in the concourse, but does not tell a passenger if it is quicker to walk or ride to their gate.

The walk vs. ride issue at DTW has a two-part solution shown in Figures 6.6 and 6.7. The MUFIDs add an extra column on the far right to indicate if a passenger should ride the Express Tram. The directional signs in the concourse indicate specific gate ranges to passengers to ride the Express Tram for the quickest connection. A comprehensive design and planning approach at DTW helps provide the passenger with a positive wayfinding experience.

6.2 Considering Terminal Users in Design (Human Factors)

6.2.1 Terminal Users Categories

There are a number of user groups that travel through airport terminal buildings. These include departing passengers, arriving passengers, passengers with a connecting flight, and non-

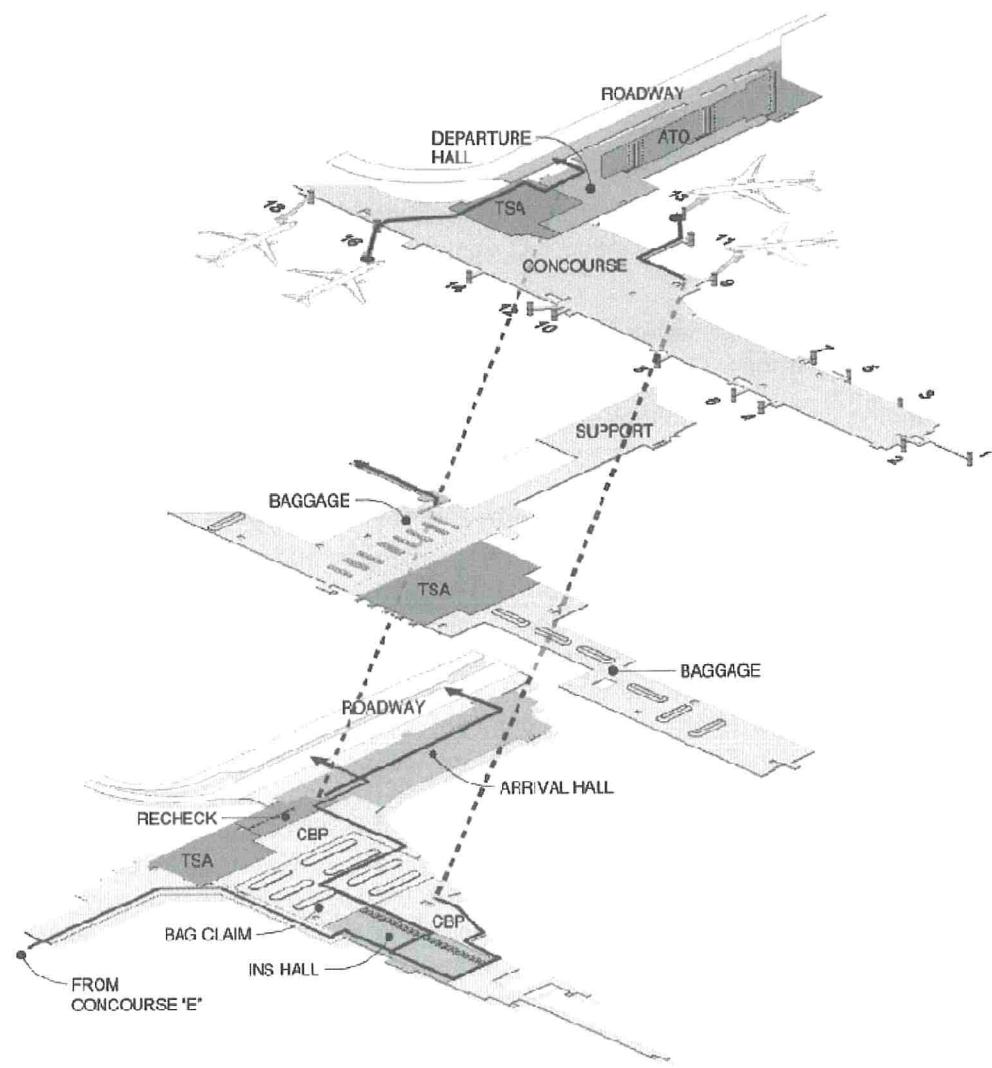


Figure 6.4. *Passenger flow diagram used for planning purposes. Red and blue dashed lines represent typical passenger circulation paths to help identify each decision point in the wayfinding journey.*

travelling visitors who are picking up or dropping off passengers. Terminal users include familiar and unfamiliar passengers and visitors. In addition, users may have physical, visual, cognitive disabilities that may make the wayfinding task more challenging. Unfamiliar passengers may have added stress from fatigue or jetlag. The wayfinding system must consider and accommodate all terminal visitors and passengers.

6.2.2 Terminal User Tasks and Information Requirements

Passengers can be separated into three basic types: departing, arriving, and connecting. Within these three types, a passenger can also be classified as a domestic or international passenger. Accounting for the information requirements for all of the various passenger combinations is a tedious but important step in developing a well planned wayfinding system.

6.2.2.1 Departing Passengers

A typical wayfinding task for the departing passenger includes the following wayfinding chain elements: entrance, ticketing counter, security checkpoint and airline gate. In addition to these,

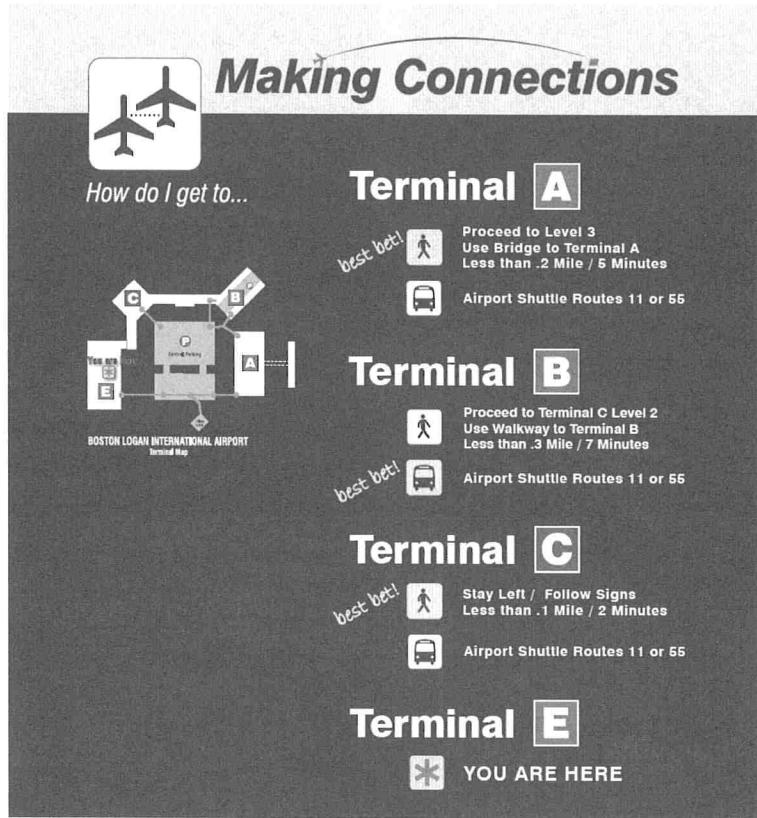


Image courtesy of: Boston Logan International Airport.

Figure 6.5. "Making Connections" at BOS is a good example of the type of planning and communication that can help overcome the complexity of architectural configuration.

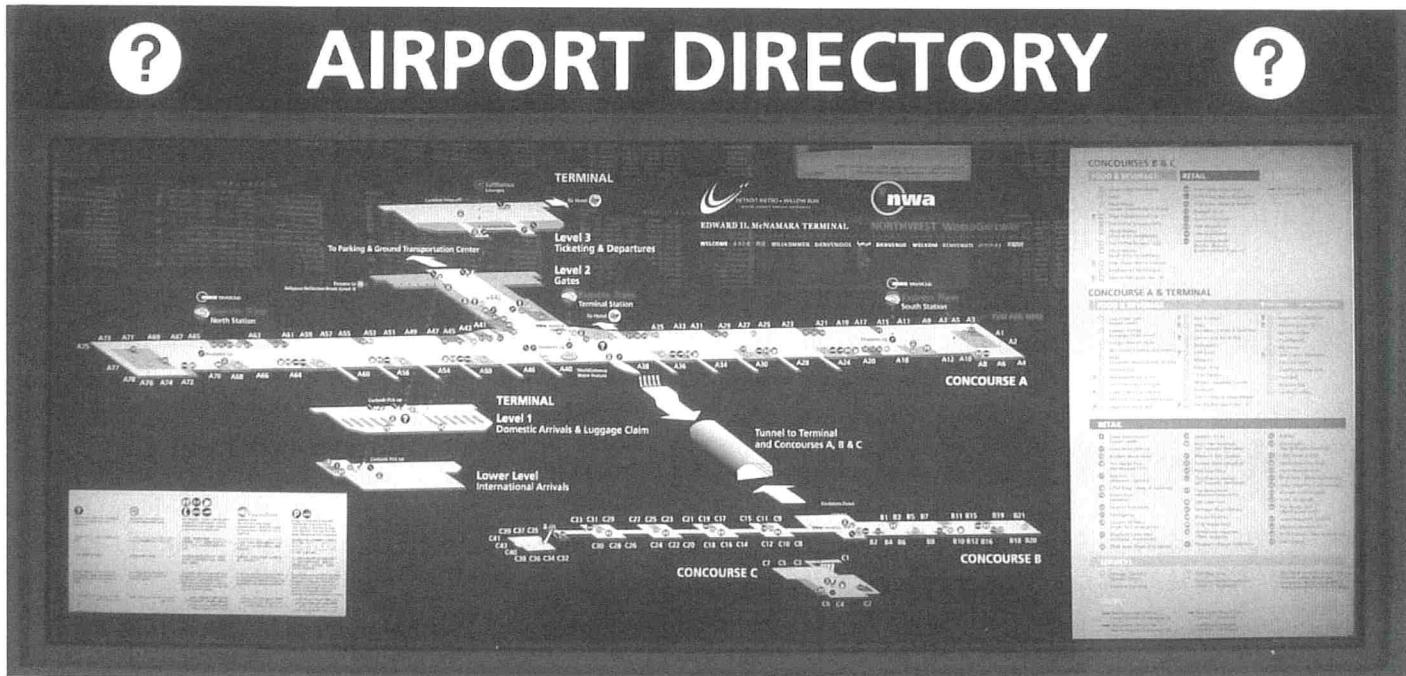


Figure 6.6. Airport directory map at DTW.

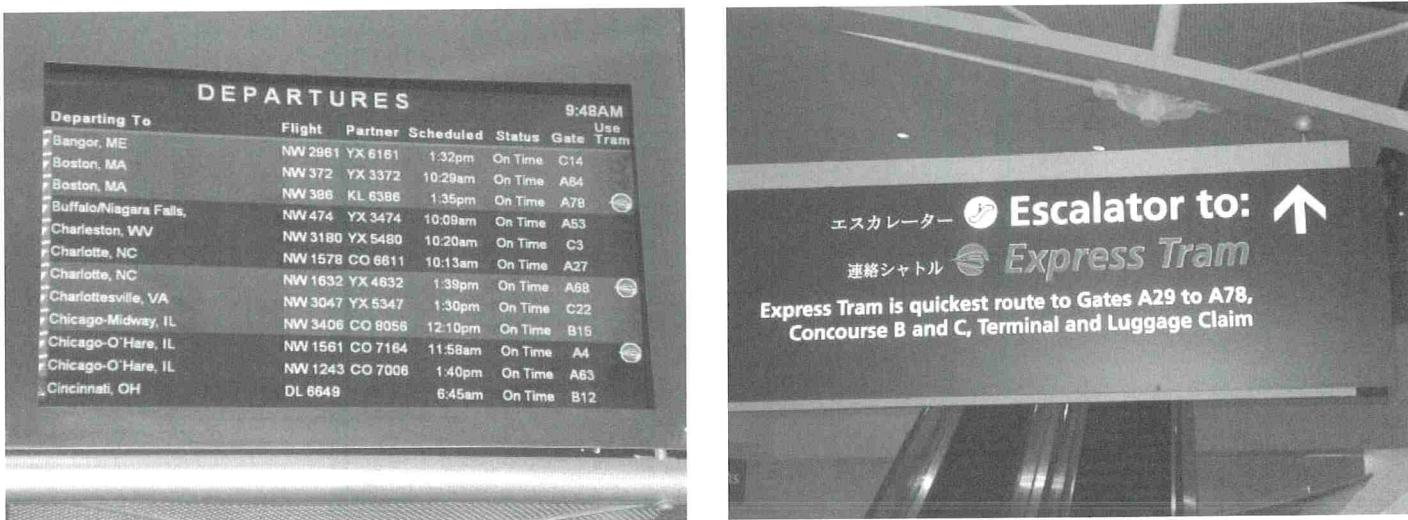


Figure 6.7. MUFIDs and directional signing at Detroit Metropolitan Wayne Airport (DTW).

other secondary destinations should also be considered such as elevators, washrooms, telephones, frequent traveler lounges, stores, Internet stations, currency exchange counters and information kiosks. Understanding the difference between these primary and secondary destinations will help airports establish a clear message hierarchy.

Many airport terminals service a large array of airlines. The scale of the departures hall and the large number of available airline ticketing counters can easily overwhelm unfamiliar passengers entering the terminal. Airline ticketing counters should be organized systematically and signs, directories, or maps should be used near entrances to direct passengers to ticketing counters that are not directly in view.

Large airports have a number of gates, sometimes spanning several buildings. For example, airports like Denver and Atlanta have gates distributed across multiple concourse buildings that are accessed primarily by underground rail. Research has shown that decision points that require a change in level have a greater negative impact on wayfinding compared to same-level decision points⁵⁶. In order to guide passengers through a complex path between origin and destination, more wayfinding tools are required such as signs, maps, and directories.

6.2.2.2 Arriving Passengers

A typical wayfinding task for an international arriving passenger includes the following primary wayfinding chain elements: passport control, customs, baggage claim area, baggage carousel, exit to parking, car rental, ground transportation, or passenger pickup. Domestic passengers experience similar wayfinding tasks minus the passport control and customs. Other secondary wayfinding destinations may include elevators, washrooms, telephones, and information counters. In large airports arriving passengers may have to walk a long distance from their gate in order to reach the baggage claim area. In these cases signs should be placed every 150–250 feet along the path to remind passengers they are heading in the right direction. Carousels in the baggage claim area should be well-marked with flight number and departure city. In large terminals that have several carousels, a directory should be placed at the entrance to the baggage claim area to identify flight information for each carousel. To aid passengers as they wait for their luggage, an information desk for ground transportation should be located adjacent to the baggage claim area.

6.2.2.3 Connecting Passengers

Many passengers arrive at an airport terminal for a layover before taking a connecting flight to their destination. For international passengers, a typical wayfinding task may include primary des-

tinations such as: arrival gate, customs, baggage claim, security checkpoint, and departure gate. Domestic passengers experience similar wayfinding tasks minus customs. For most connections, baggage is automatically transferred to the connecting flight. However passengers making a connection from an international flight are frequently required to claim their bags before making their connection. Maps are very useful in orienting passengers within a terminal, especially when they need to walk long distances, change levels, or change buildings or terminals.

6.2.3 Meeting Point for Non-travelling Visitors

Arriving passengers are frequently greeted by friends or relatives in the terminal. During peak hours these airport visitors can create a lot of congestion if they get lost within the terminal. Airports can have multiple exits so the meeter/greeter area for arriving passengers should be clearly marked on signs and directory maps.

6.2.4 Visibility Index (VI)

In order to assess the need for signs, designers should consider conducting a line of sight analysis. The simplest navigation task occurs when the destination is visible from the origin. A sight line analysis is an important tool that can be applied to determine the visibility of terminal as a whole or of its subsystems and components. Changes in layout or signage can be evaluated in terms of their visibility. The Visibility Index (VI) is a common quantitative measure used to evaluate the ease of orientation and wayfinding within a facility. The Visibility Index is established based on the availability of sight lines between key nodes within a facility^{57,58,59,60}. For an airport terminal there are many destinations for each origin, and a destination with many sight lines becomes very visible. The more visible the various origins and destinations are, the more the users are oriented. Similarly, the Visibility Index can be calculated for a chain of nodes, such as the path originating from the curb to aircraft. For a terminal to be 100% visible every destination would have to be visible from every origin. Where sight lines are not available, passengers require other devices that provide orientation information, such as signs, maps, and other visual cues.

6.3 Signs and Wayfinding

6.3.1 Departures and Arrivals Sequence

A comprehensive signage program for the terminal area begins the moment a passenger enters the building. This can be either a departing, arriving terminating, or an arriving connecting passenger. To provide an overview of the elements to consider when planning a wayfinding system for the terminal, the following represents a checklist for the primary signs:

From Ticketing

- Directional signs—overhead and/or free standing to the gate.
- Airport directories—for orientation and information.
- MUFIDs—for flight and gate information.

Security Checkpoint

- Identification of the checkpoint.
- Informational.
- Regulatory (TSA-required signs. See Chapter 8.)

Gate Area

- Directional signs—overhead or free standing to the gate.
- Airport directories—for orientation and information.

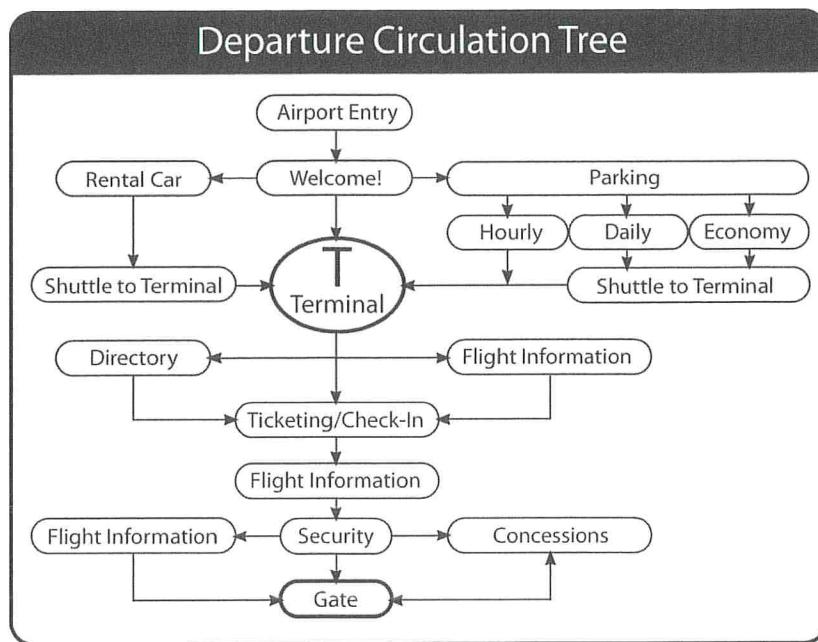


Figure 6.8. Departure circulation tree.

- MUFIDs—for flight and gate information.
- Gate identification.

Departing passengers can access a terminal by one of several means: passenger drop-off, self-park, airport or hotel shuttle, commercial vehicle, and mass transit. For passengers checking bags or without a boarding pass, step one is to provide necessary wayfinding to the ticketing level or area.

The departure circulation tree (Figure 6.8) is a generic visual representation of this wayfinding checklist. Using this information as a model, a circulation tree can be developed for any airport to track the connectivity of passenger movements and identify the decision points.

Similar checklists and circulation trees can be developed to track the connectivity and decision points for an arriving terminating passenger or an arriving connecting passenger.

6.3.2 Transit—Internal Rail System vs. External

In the last two decades there has been a revolution in rail transit at airports. A number of airports have developed train links from the airport to downtowns on top of developing rail transit to connecting airport terminals and parking. A difficulty has developed with the rise of these transit systems: the confusion between internal and external rail systems. This problem exists on the terminal landside or non-secure area.

In the follow up interviews with wayfinding design professionals they were all asked what is one of the most problematic wayfinding areas and almost every designer cited the transit connections. The case in point is demonstrated at Newark International Airport where this difficulty is most visible.

The external transportation system run by the New Jersey Department of Transportation and Amtrak is connected to the airport by the AirTrain, an internal monorail system. The wayfinding system does not properly explain the difference between the internal AirTrain and the external transit system, creating confusion among passengers that perceive it as one system. The AirTrain



Figures 6.9. Examples of AirTrain information at EWR.

is branded in some applications and generic on other signs and explained on some signs and not on others (Figure 6.9).

The on-airport AirTrain makes frequent stops around the airport—including the airline terminals, parking lots, hotel shuttle areas and rental car facilities (Figure 6.10). Also, every AirTrain ride around the airport is free. The off-airport AirTrain Newark provides easy connections to and from NJ TRANSIT and Amtrak through one gateway—Newark Liberty International Airport Station.

Many airport designers see the solution in differentiation. This can be accomplished by ensuring that rail transit to the city looks like it is part of an overarching urban system; the internal airport transportation system is integrated into the overall airport wayfinding, rather than looking like a unique entity.

At Boston Logan International Airport, the transportation system from the airport to the city is called the Silver Line, similar to the color structure of other transit links to the city. This transit link is portrayed in maps at the same time. Meanwhile the internal transit system, the Logan shuttle, is clearly linked with the wayfinding system internal to the airport. Both transit systems use buses as the means of transport. The differing graphic identity and wayfinding systems are what keep the two systems from being confused with each other.

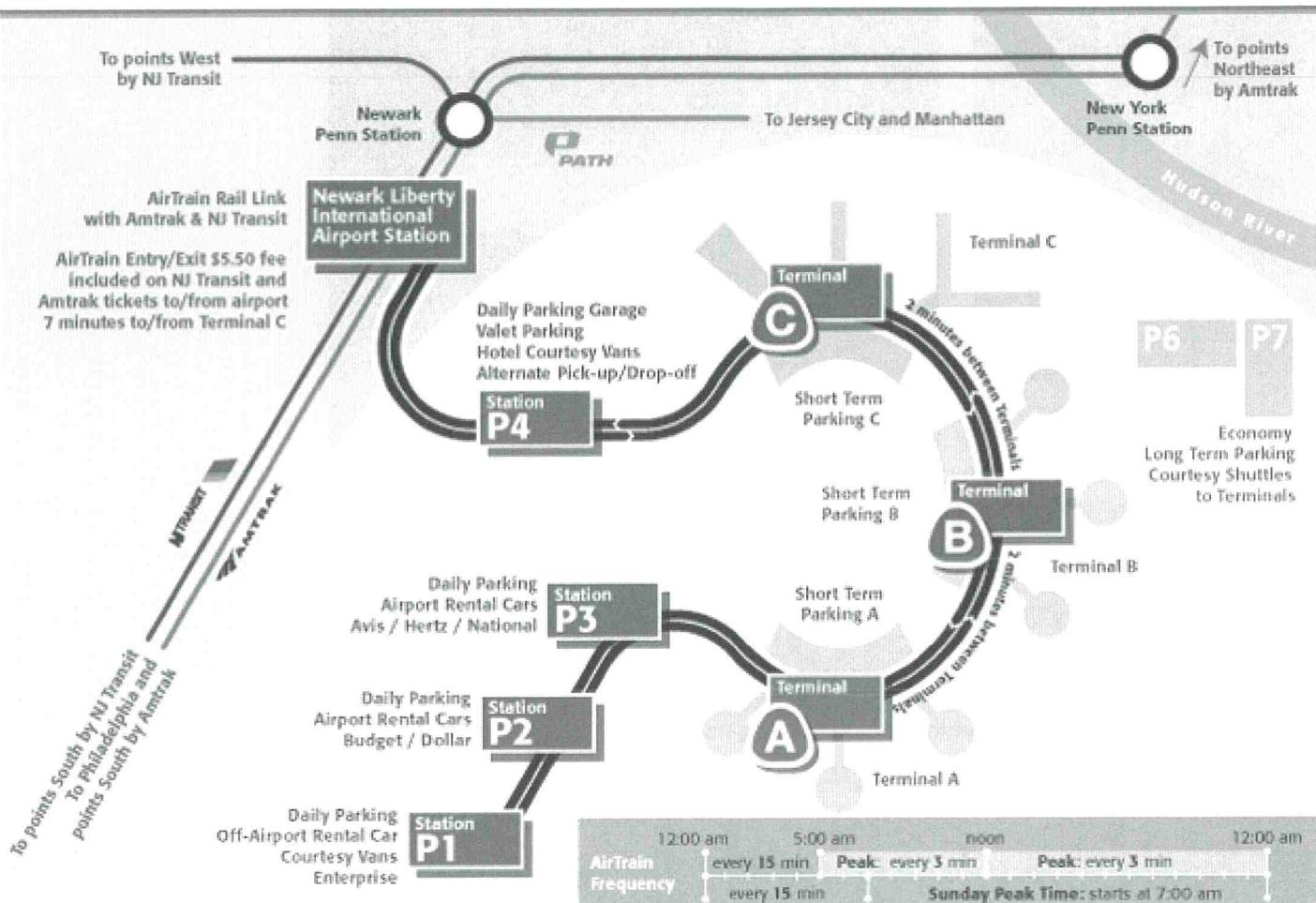


Figure 6.10. Examples of AirTrain Map at EWR.

On the airside or secure area of the airport several airports have chosen to brand their trains that serve as an APM system between terminals, concourses, and gates. The odds of these trains being confused with any train service on the landside is minimized because only ticketed passengers have access to these trains.

However, there is a potential for confusion for unfamiliar passengers who may not understand what this branded service is. Therefore, the signing for these types of trains can require additional information such as the examples show in Figures 6.11a and 6.11b.

6.3.3 Security Screening Checkpoints (SSCP)

Since 9/11 security checkpoints have become in some people's eyes a destination that should be part of the wayfinding system. However, security checkpoints can be one of the more stressful aspects of the passenger experience. Each airport layout is different but typically all that is necessary is simple identification that is not overly exaggerated.

Areas like security and customs are operated by the TSA (Transportation and Security Administration) and CBP (Customs and Border Protection) respectively. Both areas are controlled separately from the airport and can create breaks in the wayfinding continuity. Therefore, the wayfinding to and through the security checkpoints should focus on directing passengers to the gates located past security. Minimizing the attention given to security checkpoints will help combat the negative perceptions associated with why they are there as well as the process itself.



(a)



(b)

Figure 6.11a. DFW Skylink connects all gates; Figure 6.11b. DTW Express Tram connects only the A gates in the McNamara Terminal.

There can be exceptions. Some airports have had to add new security checkpoints creating choices for the passenger and may justify the need to include “Security Checkpoint” as part of the wayfinding system.

Throughput is a top priority and providing information in advance that prepares passengers for the security activities is more important than identifying the security checkpoint itself.

6.4 Sign Categories

6.4.1 Informational

Informational messages typically provide specific and supplementary information about the airport services and functions. Also there are orientational messages that are often graphic, such as maps, so that visitors can develop a sense of the airport layout and their location within the airport. Information can also be provided by airport personnel at information desks.

6.4.1.1 Information Desks and Volunteers

Information desks and kiosks provide flight information. Therefore airports should provide training for staff and volunteers on the best methods to give clear instructions and directions on using the airport wayfinding system. Their experience consoling worried passengers provides a key component to the passenger wayfinding experience (Figure 6.12).

Prepare an information book for volunteer use with scripted directions to insure consistent instruction. Train volunteers and staff in giving directions using signs and handouts. Interpreters should also be able to help orient people to the facility and play a role in teaching people how to use the sign system on their own.

Develop requirements and skills for these positions that could include the following:

- Knowledge of the airport facility and operations.
- Direct people to appropriate destinations or services.
- Ability to answer the commonly asked questions regarding passenger services.
- Enjoy working with people of all ages.

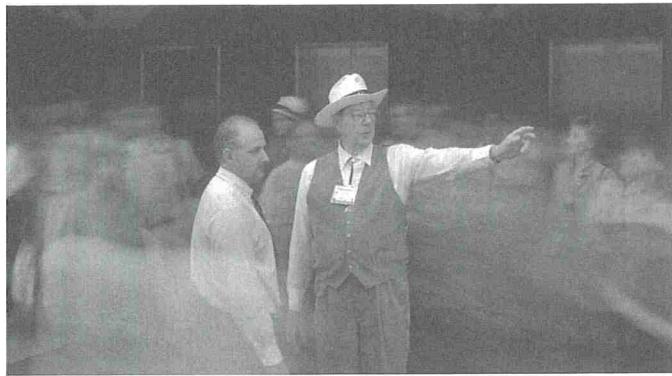


Photo courtesy of Denver International Airport.

Figure 6.12. *An airport ambassador at DIA, dressed in western wear, helps answer questions from an arriving passenger.*

- Ability to work with large groups and deal with the possible confusion and noise that often accompanies large crowds.
- Computer skills for staff stationed at an information desk with internet access.
- Proficiency in English both written and verbal.

6.4.1.2 Directories

Airport directories are one of several ways passenger use to navigate the airport. They are an important wayfinding tool, and are effective when implemented correctly. For many years all airport directories were static images, but with advances in technology digital directories applications are becoming available. The following list contains general guidelines for directories:

- Directories should be located:
 - Appropriately at major decision points.
 - Near an asymmetrical part of the building or landmark so people have some feature to key on when possible.
 - Near information desks when possible.
- Include orientation on two levels
 - Big picture that conveys the overall layout of the airport.
 - Specific area details around the directory location.
- Align the map in a heads up orientation so forward is up, and make sure the map is aligned with the airport's layout.
- Incorporate memorable architectural elements and landmarks into the map design when possible.
- Use terminology and symbols that are consistent airport wide.
- Coordinate directory information with other forms of communication for consistency
 - Handout maps.
 - Online maps.

It is important to understand that some passengers will not devote time to the study of maps and signs, and opt instead to ask for verbal route directions. This is why it is a good idea to locate directories and information desks with a live person near each other whenever possible.

6.4.1.3 Digital Directories

Options for digital applications for directories continue to evolve. Digital directory applications can be separated into two basic categories: passive and interactive. Passive digital directories display a static image using a flat screen monitor. Interactive directories allow users to search



CASE STUDY

“You Are Here” Maps

A U.S. study⁴¹ evaluated airport terminal wayfinding systems at O'Hare airport in Chicago, focusing on visual elements such as signs, maps, and directions (Figure 6.13). The experimental design used respondent self-reporting and behavior tracing to identify specific problems that lead to poor spatial orientation and wayfinding performance. In a survey, infrequent travelers reported that they perceived the "you are here" and corridor signs were with the most important information sources for navigation.

A separate sample of 19 passengers was asked to consult the "you are here" map to determine the appropriate heading and direction to the desired facility. Only 2 of the 19 passengers were able to determine the correct course of action. Frequent comments included, "I'm not even sure where I am on this map" and, "Now that I know where it is, how do I get there?" The authors attribute the poor performance of the "you are here" sign to the fixed alignment of the map which is misaligned with the orientation of the passenger. Fewings also emphasizes the importance of using pre-aligned "you are here" maps so that forward is up and the map is aligned with the airport layout.

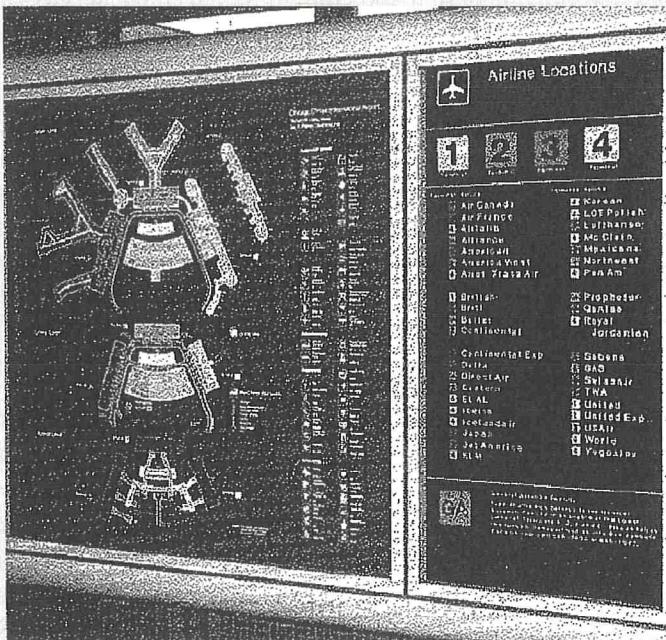


Figure 6.13. More than 90 of these you-are-here map displays are located throughout O'Hare International Airport.

for information using touch screen panels. While there is no established best practice, the following is a list of 5 considerations airports should address when considering integration of interactive wayfinding into their overall directional wayfinding schema.

Map-driven vs. intent-driven organization of wayfinding content. One of the biggest opportunities in the market is to orient the content towards the viewers' specific needs—for instance, presenting all Points of Interest (POI) available in an airport, concourse, property such as emergency, medical, and administration vs. POI for specific passenger needs such as Quick Serve Restaurants (QSR) and other Retail concessionaires. It may be a better use of resources to reserve Interactive Wayfinding for more heavily searched POI such as concessionaires.

The efficiency of a singular user experience vs. a multi-user experience. Airport patrons have become accustomed to interactive experiences delivered via kiosk, be it check-in or rental car, while they have traditionally digested directional and wayfinding information in a much less intimate manner through static signs and large, printed public display maps. Questions to answer: If a large format screen is programmed to provide wayfinding information, will people use it? Does its size leave people feeling exposed, knowing that others may "eavesdrop" as to what they are looking for? Is wayfinding more aptly handled in the manner of current interactives, via kiosk? Is so, how do you encourage the general public to interact with them?

Management of interactive wayfinding systems. Printed wayfinding signs have traditionally proven to be costly and have very limited life cycles. And while digital signage and Interactive Wayfinding are significant steps in alleviating some of those costs, Administrators should realize and appropriate resources for continued management of these systems. Manufacturers, resellers, or agencies that provide design and content management services should be favored when weighing these considerations. Systems that also offer the simplicity and flexibility of being managed by Airport Staff should also be given weighted consideration.

Using an interactive wayfinding system as a value-add or revenue generating mechanism. Investment in interactive wayfinding is not an inconsequential expenditure. How do Airport Administrators maximize that investment and shorten the ROI realization term? Diligent interactive wayfinding systems will allow for value added options like wireless coupons or ad driven content. Administrators can also take advantage of interaction metrics that are reported back by the digital signage system. These metrics can be used to improve user interface design, spot search trends (for use in facility planning, i.e., where to place more amenities), and to discover hidden user behavior patterns.

Buying vs. leasing an interactive wayfinding system. Today, more progressive agencies and manufacturers realize the Moore's law-type effect associated with technology and hardware: what's cutting edge this year, may be obsolete two years after implementation. So how do airports protect themselves from this effect? More and more end-users are electing to lease equipment for terms of 3–5 years, depending on use. The market will begin to see more facilities elect for lease options that allow them to return equipment at the end of limited terms in exchange for updated equipment. The service model will continue to trend towards a Software as a Service (SaaS) model that has been popularized within other business markets. For additional information, reference Sections 7.2.25 and 7.2.26.

6.4.2 Directional

Directional signs are of great importance in the facility due to the fact that they are the main information source that enables passengers and visitors to choose the proper route to a specific destination point. This process involves selecting the correct path to a destination point and determining at which point a change of direction is required. Proper directional signing is nec-

essary since the quick movement of visitors, employees, and passengers is essential for maximum utilization and efficiency of the facility.

Directional signs at transition points are especially important for passengers to make the correct decision. These transition points include both horizontal and vertical movements. Horizontal transition points where passengers are moving from one area of the airport to another typically create challenges that require careful planning to avoid any misdirection or gaps. Transitioning from the terminal area to a congested and confusing ground transportation area is one such example.

Vertical transition points can be even more difficult for passengers, because the use of stairs, escalators, and elevators can physically require the passenger to turn themselves around. The result can be a passenger that needs to be re-oriented as they transition to a different level. The re-orientation can be accomplished with something as simple as an elevator directory or as complex as an airport directory to help the passenger know where they are in relation to their destination.

6.4.3 Identification

Identification messages mark terminals, gates, ticketing, and baggage claim locations, as well as, provide tenants' leasing space within the airport with proper public exposure to their areas and other spaces governed by the airport. Directional and identification signs go hand-in-hand. Like a period at the end of a sentence, every direction must have a confirmation, so passengers know they have reached their destination. The identification sign is the metaphorical wayfinding period.

6.4.4 Regulatory

Regulatory/safety messages relate to Federal Aviation Administration (FAA) requirements and recommendations as well as other federal, state, and city regulations. In general, these messages provide passengers with travel advice, warnings and legal restrictions. See Chapter 8 for a list of federally required signs.

6.5 Sign Design Elements

6.5.1 Terminology

The goal to provide consistent terminology goes beyond a single airport. In order to improve the passenger wayfinding experience on a national and even global level it is important to establish consistent terminology from one airport to another.

Note: A key companion to terminology is the consistent application of the symbols as well. The combination of terminology and symbology form the backbone of an airport wayfinding system. A message and its accompanying symbol create a symbiotic relationship and should always be perceived as belonging together. In other words the two elements are mutually beneficial. Virtually every research document and every survey confirms this basic philosophy.

Another key concept when developing terminology for informational, regulatory and security checkpoint messages is to focus on maintaining a positive voice. What does this mean? Many regulatory and security checkpoint signs convey messages with a negative voice. Look for opportunities to craft language that removes the negative connotations without sacrificing the intent of the message being communicated.

The survey research among airports and design professionals indicates the term Concourse is being replaced with Gate. The logic behind this trend is that Concourse is an architectural term and

not the final destination. The Gate is a departing passenger's ultimate destination. In application, this approach simplifies the sign layout by reducing the amount of messaging. While the wayfinding philosophy may be sound, the architectural layout of an airport has a huge impact on the messaging and needs to be part of an overall conscientious evaluation before making a change like this.

6.5.1.1 Message Hierarchy

People are able to deal with only a limited amount of information at any one time. Prioritizing of information is critical to avoid psychological overloading, which results in confusion, stress, and frustration. In airport terminals, where movement to specific gates or exit points is most important to passengers, primary directional information should be the most salient. Often, however, this is not the case and secondary types of information like services and concessions are placed on the level with the primary directional messages.

This approach slows passengers down and confuses them. Separating primary versus secondary information is essential. This can be accomplished by establishing a uniform hierarchy of messaging throughout the airport to provide clear, consistent presentation of information to passengers. Sign messages can be categorized into three basic lists:

- Primary,
- Secondary, and
- Tertiary.

Clear and concise information presented by primary and secondary signing systems ensures efficient passenger circulation. Primary information shall be the largest and most visible message on each sign. Recommended terminology for primary information shall include directions to:

- Terminal(s),
- Ticketing/Check-In,
- Baggage Claim,
- Gates, and
- Ground Transportation.

This list can also include Concourses however the current practice among airports and design professionals indicates the use of Concourse is being replaced with Gate. The airport surveys also gathered data on the terms for "area to pick up luggage" (Exhibit 6.1) and terms used to direct passengers to the general area for mass and individual transit (Exhibit 6.2).

Secondary information supplements or reinforces information already conveyed by the primary messages listed above. It usually indicates the services and support functions of the facility.

Exhibit 6-1. Survey of terms for "area to pick up luggage."

Term	Number of Airports	%
Baggage Claim	21	68%
Bag Claim	5	16%
Arrivals	0	0%
Arriving Flights	1	3%
Other*	3	10%
No response	1	3%
Total	31	100%

*"Other" responses included the term Luggage Claim that was used in one airport terminal and Baggage Claim in another terminal. An interesting way to solve this debate is to consider that all baggage is not luggage; but all luggage is considered baggage. Therefore, the most descriptive term is Baggage Claim.

Exhibit 6.2. Survey of terms used for mass and individual transit.

Term	Number of Airports	%
Ground Transportation	25	81%
Ground Transport	0	0%
Taxi, Bus & Shuttles	0	0%
Other	2	6%
No response	4	13%
Total	31	100%

Recommended terminology for secondary information should include directions to:

- Restrooms,
- Parking,
- Concessions,
- Telephones, and
- Elevators.

Tertiary information supplements both the primary and secondary messages and is usually intended to inform visitors of regulations and warnings. Tertiary signs must be coordinated with Primary and Secondary signs and interior design elements. All of the regulatory/safety signs are generally considered to be tertiary.

Recommended terminology for tertiary information is to include:

- All “No Smoking” messages,
- FAA required warnings and information, and
- Other messages required by code.

It is important to understand that the same message may fall under a different category depending on its use. For example, a visitor on the roadway approaching the terminal may find the term Parking as the primary message. However, the same Parking term may also be found by a visitor in the terminal and considered a secondary destination.

In general, emphasis shall be placed on the reduction of signs and sign content where possible. Additionally, the sign system shall move from the general to the more specific, as a user traverses the terminal.

The previous lists can be effectively used to establish a standard message hierarchy. Every airport has a different set of variables that will impact the results and this can sometimes make this seemingly simple task of establishing a clear hierarchy very complex. The case study from DFW is a good example of how to develop a message hierarchy to meet specific needs.

Airport surveys indicated the majority of airports are using Arrivals and Departures for signing on the roadway. What is not known is how many of these airports have a single-level curbside vs. a split-level curbside and how that may impact their choice of messaging. Most airports with a split-level curbside use Arrivals and Departures, and conversely airports with a single-level curbside tend to use Baggage Claim and Ticketing Check-In so their single-level curbside aligns better with the services inside the terminal.

There is also a related issue regarding the terminology being used inside the airport that should be considered. For instance, at a multi-level terminal, an arriving passenger may communicate to someone picking them up to look for the sign for Baggage Claim. Instead, the person driving the roadway sees the message Arrivals. The two messages do not match. To ensure consistent communication having each entrance to the terminal clearly identified from both the inside and outside to serve as a consistent point of reference will help facilitate passenger pick-up. Figures 6.14 through 6.16 illustrate one method of establishing a consistent point of reference to help facilitate passenger pick-up.

 **CASE STUDY**
Developing a Message Hierarchy

An airport can develop a messaging hierarchy specifically based on their needs. The following outline is a three-step process developed to help DFW airport determine what would work best at their facility.

Step One: Group destinations in order of passenger information that is most critical to least critical based on stress factors and time:

High Stress (Time-Sensitive)	Medium to Low Stress	Lowest Stress
<ul style="list-style-type: none"> • All Gates • Terminals/Ticketing • Skylink (connecting passengers) • Walk to . . ./Elevator to . . . • Airport Information (maps) • Restrooms (for arriving passengers) 	<ul style="list-style-type: none"> • Skybridge to . . . • Restrooms • Bag Claim • Ground Transportation 	<ul style="list-style-type: none"> • Exit • Parking • Concessions

Step Two: Group destinations by passenger type and then by degree of urgency.

Arriving—Connecting	Arriving—O & D	Departing—O & D
<ul style="list-style-type: none"> • Gate • Skylink • Skybridge • Restrooms • Concessions 	<ul style="list-style-type: none"> • Restrooms • Bag Claim • Ground Transportation • Exit • Parking 	<ul style="list-style-type: none"> • Ticketing • Security Checkpoint • Gate • Restrooms • Concessions

Step Three: Consistent implementation of the messaging hierarchy criteria.

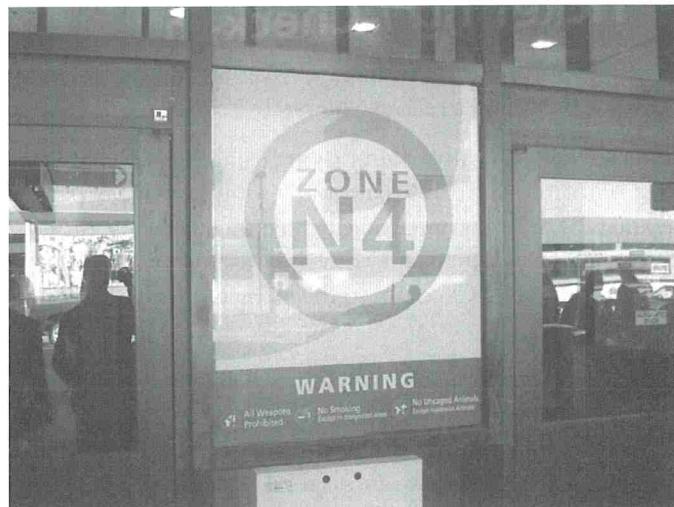


Figure 6.14. Exterior entrance identification—ATL.



Figure 6.15. Interior entrance identification—ATL.

6.5.1.2 Bilingual and Multilingual Messaging

While English is recognized and used worldwide, there is still a need to make a foreign passenger welcome because our airports serve as gateways to the United States. There are also other variables that factor into how and where non-English messaging should be used and what is an acceptable LOS.

Airports need a balance between the domestic and the global in informative and symbolic signing. Examining the leading airports in non-English speaking countries reveals three patterns:

- A totally global pattern ignoring the domestic,
- A pattern treating equally the global and the domestic, and
- A pattern of giving preference to the domestic with the global being subordinate.

An example, and maybe the only existing case, for the totally international option is Amsterdam's Schiphol Airport which carries signs in English only with black letters on a yellow background. Examples of the second, balanced option between the domestic and the global are Toronto, which displays English and French side-by-side with equally sized letters (Figure 6.17)



Figure 6.16. Curbside entrance identification—ATL.



Figure 6.17. Signs at Toronto Pearson International Airport display English and French side-by-side with equally sized letters.

and Hong Kong, which portrays blue signs with white letters, with German and Chinese, respectively, on top and English underneath, all languages with equally sized letters (Figure 6.18).

Examples of the third option, leaning more to the domestic, are Paris' Charles de Gaulle and Tokyo's Narita. In Figure 6.19, signs are in gray with French on top using yellow, and thus striking, letters and with English underneath using white letters. Thus, the initial visual perception is French. In Narita Airport (Figure 6.20), signs are in grey and lettering is in white with the Japanese text on top in slightly larger letters than the English texts underneath.

When bilingual or multilingual messaging is used, translations should be different from, but not subordinate to, the English messages. The same lettering style can be used for both, but then



Figure 6.18. Signs at Hong Kong International Airport are blue with white letters, with German and Chinese, respectively, on top and English underneath, all languages with equally sized letters.



Figure 6.19. Example of domestic message over global message at Paris Charles de Gaulle.

they can be presented in different colors, text weights, and copy height, and positioned in a manner that clearly separates them from the English. Various graphic elements can assist in the clarity and legibility of the sign messages.

Both approaches are used in international airports. The key to the answer is consistency, and what is realistically achievable. The constraints include three major dimensions within the physical airport terminal environment:

- Architecture,
- Floor plan layout, and
- Signing.

The physical size of a sign panel can be dictated by architectural space constraints, (e.g., ceiling height), which in turn limits the amount of information that can realistically be placed on the sign panel.

The constraints associated with trying to incorporate multiple languages on a sign can be very challenging. Different messages (words) in different languages can vary greatly in line length, which impacts the sign layout because each language does not always fit line for line from sign to sign.

As part of the survey process airports were asked how they used languages other than English in terminal wayfinding signs. Thirty-nine percent of the airports surveyed had languages other



Figure 6.20. Example of domestic message over global message at Tokyo Narita Airport.

than English on some form of their terminal wayfinding signs. The primary use of non-English languages is in the International Arrivals area which is logical and promotes a higher passenger LOS. Multiple airports use DMS technology to support multi-lingual needs in the international area and avoid many of the problems associated with multiple languages on static signs.

Additional variables influence the use of other languages in areas beyond the International Arrival area such as:

- A high percentage of non-English speaking travelers
- Airlines
- Major business corporations

The combination of the research and surveys helped serve as an outline for best practices by providing appropriate alternative non-English wayfinding tools for non-English speaking passengers:

- Consistent application of accepted international symbols adjacent to English only messaging.
- Bi-lingual or multi-lingual airport guides that use accepted international symbols.
- Bi-lingual or multi-lingual airport directories that use accepted international symbols.
- Airport information attendants with bi-lingual or multi-lingual skills.

Summary

Adopting an English-only policy certainly simplifies the wayfinding system and is appropriate in most applications. However, it may not always meet the needs in every situation, (e.g. international arrival areas). Each airport should evaluate their individual needs and develop best practices for addressing bi-lingual and multi-lingual needs that work successfully in a given set of constraints for their airport.

6.5.2 Symbology

This section addresses the proper use of symbols in airport wayfinding systems.

Note: it is not the purpose of this guide to develop a new family of aviation symbol standards, or to recommend changes to the existing currently accepted standards. Rather, this section gives a brief historical overview of symbol development, talks about the ways in which symbols should and should not be used, and provides a visual inventory of the most widely accepted symbol standards in current use.

Symbols are the oldest form of visual communication. Long before written languages appeared, pictographs or symbols were used by humans to represent objects and activities and to tell stories. As civilizations grew and societies and commerce became more organized, symbols played an important role in communicating information to non-literate populations, and to travelers who did not speak the local language.

Non-standardized symbols were the norm until the twentieth century, when the advent of modern motorized transportation created an exponential increase in international travel. As symbols became more prevalent in airports and other transit facilities, there was increased interest in developing a worldwide standard for symbols that could serve as a tool for communication—a common visual language.

The goal has always been to facilitate the traveler's understanding and utilization of the facility. The consistent pairing of text and related symbols can provide a powerful communication tool for travelers. Once symbols are learned they become a visual "shorthand," as well as a means of communication for those who do not understand the local language. This shorthand offers an added benefit of shortening the time required for a traveler to perceive and process the information.

It is true that some symbols are more universally understood than others. An airplane is recognized by any traveler, whereas the symbols representing Chapel, Currency, Meeting Area, or Rental Car may be less concrete and/or subject to differing interpretations based on the viewer's culture and background. Even in such cases, recognition and comprehension will increase with usage, as viewers learn to associate symbols with what they represent.

Furthermore, when properly deployed, symbols are an efficient means of communicating key destinations and services to non-English-speaking travelers. This learning process can be helped through the display of multilingual messages linked with symbols at key selected locations such as arrival gates and directories (Figure 6.21).

6.5.2.1 *Symbol Family*

Since 1962 there have been multiple efforts to develop a single standard for a family of pictographic symbols to identify activities and services for the traveling public.

To the extent that a current standard exists, the symbol family developed by the American Institute of Graphic Arts for the U.S. DOT is the most commonly recognized. However, as any traveler can attest, multiple variations have been introduced as these symbols have been adopted for use by airports around the world.

Currently, these symbols and their variations are in use in over 90% of international airports in the United States. In this section you will find an overview of the most commonly used symbols as depicted in the current 2001 Guideline, which incorporates the AIGA/DOT standards with



Figure 6.21. Gate 1D pylon at DFW used a touch point to connect symbols with multiple foreign languages.

some updates and additions. Note: in certain instances where potential issues and/or conflicts related to specific symbols or messages have been identified, a recommended change in terminology or use of a recommended alternate symbol has been noted in the overview. Recommended changes in terminology are noted in the captions below each symbol; recommended alternate or new symbols are shown immediately following the existing (2001) symbol and identified as the recommended replacement or addition.

6.5.2.2 Symbol Application and Usage

When using symbols, it is important to keep the following basic principles in mind:

A clear and consistent pairing of symbol and associated message reinforces the symbol's effectiveness. Once this association has been firmly established, some of the more common symbols can function as stand-alone communicators (the "shorthand" referenced above). This may be useful for limited-space display of key destinations (e.g., flag-mounted Restroom symbol as seen in Figure 6.22), but should be limited to the most commonly understood symbols and key destinations.

Consistency in placement and visual presentation of symbols creates the greatest level of recognition and shortens the time required to process the message. Variations in symbol size, placement on signs, and background colors should be kept to a minimum within an individual facility. Note: in rare instances there may be existing cultural, environmental, or architectural conditions that dictate a need for customization of symbols (colors, use of field, etc.) in order to maximize the effectiveness of the system. In such cases the goal should be to maintain the standard to the highest degree possible while remaining sensitive to any special conditions.

In addition, it is useful to conduct a periodic symbol "inventory" to ensure that symbol selection and usage is consistent throughout all of the airport's visual communication platforms—signage, print, and online applications. This cross-platform consistency is an important part of reinforcing the symbol language and making it recognizable for travelers.

Symbol readability is a function of many combined factors, including size, viewing angle and distance, color, background contrast, and the type, direction and intensity of lighting. Field testing using full-scale mockups is by far the most reliable way to confirm the effectiveness of any symbol application, for both readability and comprehension.



Figure 6.22. A stand-alone flag-mounted restroom symbol.

Human factors, including visual acuity, age, understanding of language, distraction, and stress can also impact the effectiveness and comprehension of symbols and related messages—another reason for field-testing with selected, representative user groups to confirm that symbols are seen, recognized, and understood.

In any wayfinding system, it is important to guard against overloading the environment with information, either by putting too many messages on an individual sign, or by using too many signs, or both (Figure 6.23).

This requires the prioritizing of messages so that the destinations and services most important to travelers (e.g., arrivals, departures, ticketing, baggage claim, transportation, concourse/gate, and restrooms) are always prominently displayed. It is worth noting that there are some standard symbols that may be used to represent a collection of individual destinations or services (e.g., Ground Transportation = Taxi + Hotel Shuttle + Train + Rental Car etc). To avoid over-messaging in this example, Ground Transportation can serve as a single designation on signage until the traveler nears the baggage area, at which point Ground Transportation can be “unpacked” into its various components.

Occasionally designers have attempted to address the issue of collective destinations by linking a single term with a group of symbols, often at reduced size. This tends to compromise symbol legibility and is not recommended practice (Figures 6.24 and 6.25).

6.5.2.3 Symbol Size

Figure 6.26 shows the result of a test of the symbol for Ticket Purchase, to determine the minimum size at which the symbol was legible at different viewing distances. For the purpose of this test, legibility was defined as the accurate visual perception of the symbol and the ability to distinguish it from other symbols.

Note: some symbols are by nature more legible than others. For example, in the viewing test, symbols for Taxi and Elevator were also tested; the Taxi symbol was legible at a distance approximately 10% greater than the Ticket Purchase symbol, while the Elevator symbol was only legible at distances approximately 30% less. When sizing symbols, the determination should be based on the legibility of the least legible (commonly used) symbols in the system. Symbols that appear together should always be of a uniform size. Symbol sizes should never be varied in an



Figure 6.23. Example of information overload with a combination of format, number of signs, and amount of information.



Figure 6.24. *Bad examples of grouping symbols with a single message.*

attempt to visually “balance” or “equalize” them—this will lessen the overall legibility of the message being presented.

It is also important to consider the relationship between symbol size and the letter size of associated text. A rule of thumb for legible letter size for pedestrians is one inch of letter height for every 40 feet of viewing distance (a 3-inch tall letter is legible at 120 feet). As with symbols, however, legibility of text is affected by many other factors (typestyle, placement, lighting, visual acu-



Figure 6.25. *A good example of symbols grouped to convey a common message.*

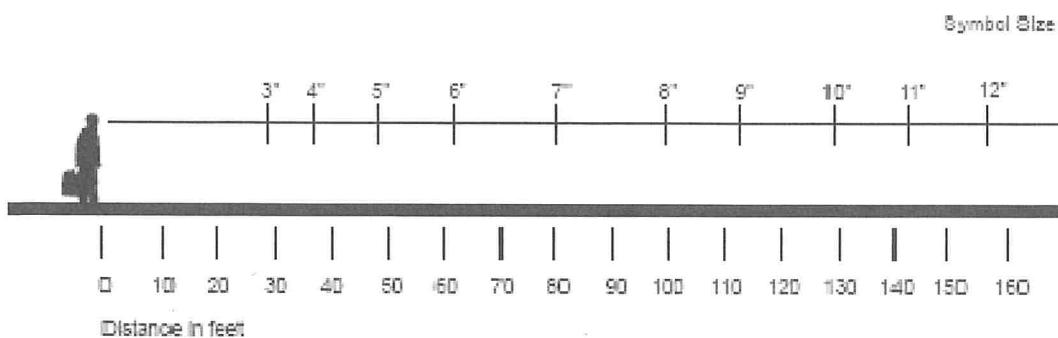


Figure 6.26. The result of a test of the symbol for "Ticket Purchase."

ity of the viewer etc), reinforcing the need for field testing just as with symbols (see Section 6.5.3). Relative placement of the symbol and text is also important. The goal is to achieve equal legibility between words and symbols when paired, in order to reinforce the connection and improve comprehension.

Another factor affecting readability of symbols, text, and graphics is their placement relative to the viewer.

Viewing angle refers to the degree of offset from the normal viewing plane. A good rule of thumb is to keep all signage and graphics within a 10-degree angle of the viewer's natural line of sight as measured from the maximum readable viewing distance. When this angle is exceeded the symbol/text legibility is reduced and may need to be compensated through increased size or lighting.

6.5.2.4 Color, Field, and Contrast

Although the most common current standards typically show a dark symbol on a white background contained within a square field with rounded corners, there are many variations currently in use (Figure 6.27). Some systems reverse the colors to display a white symbol on a dark field. Some display the symbol without a field (sometimes done to maximize the size). Some employ colors that relate to an existing airport color scheme.

Regardless of the individual colors used, care must be taken to ensure that there is adequate contrast between the symbol and the background upon which it appears for good legibility.

When specifying symbols, the best practice is to follow the current standards as closely as possible. It is especially important to maintain consistency of presentation (i.e., color, size, use of field) for symbols within an individual airport or airport system.

6.5.2.5 Use of Grid

Visual consistency within a system is an important factor in helping viewers to "learn" the system. The placement of elements such as symbols, arrows, and text relative to each other is a key part of this consistency. A grid should be developed to define the position of symbols and other elements and to establish the correct amount of separation between elements (Figure 6.28a and 6.28b).



Figure 6.27. Examples of the same symbol used in various configurations.

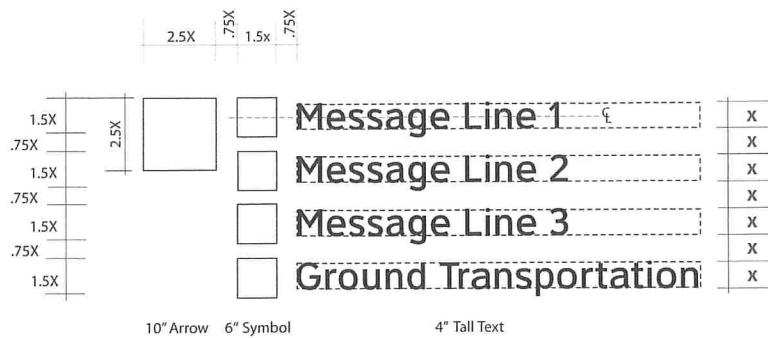


Figure 6.28a. Example grid used to establish visual consistency for placement of arrows, symbols and messages.



Figure 6.28b. Photo illustrating the example grid from Figure 6.28a.

6.5.2.6 Lighting

It would be difficult to overstate the importance of proper lighting for legibility of signage and graphics, including symbols. Fixture and bulb type, placement, and intensity are all factors that can significantly enhance or detract from a sign's legibility. Some general guidelines follow; however, it is always advisable to work with a qualified lighting designer to ensure that proper lighting is achieved.

Source type selection should take into account the sign construction and placement. Whether the light source is external or internal to the sign may dictate how big it can be and how much heat generation is acceptable.

If the light source is external, care must be taken to ensure that light is evenly distributed on the viewing surface, with no hot spots or glare. Avoid placing external fixtures in such a way that light is reflected directly into the viewer's eye; this can severely degrade readability.

For internal light sources, the intensity of the light output should be calibrated to provide even illumination with no hot spots. Overly intense illumination can also produce an undesirable effect known as "halation," in which illuminated graphics and characters tend to blur or merge together, becoming less distinct.

6.5.2.7 Field Testing

As noted, there are many factors and variables that affect symbol readability and comprehension. It is always recommended that signage elements, including symbols, be field tested prior to full implementation of the program.

The most reliable way to test a symbol or symbol/text group for legibility is to produce a full-size mock-up of the sign and place it in the actual scheduled location. If the actual location is unavailable (e.g., not yet constructed), the alternative is to duplicate the actual viewing condition as closely as possible.

When testing for legibility, it is important to engage a representative cross section of user groups (age, nationality, etc) to ensure that the symbol is recognized by the largest number of people. It is also important to remember that the viewer's state of mind can also affect the receipt and processing of information. A viewer who is stressed, distracted, or in a hurry (all common occurrences in an airport environment) will not process at a "normal" rate. To maximize the accuracy of any field test, it should be conducted under "real life" conditions whenever possible.

Testing for symbol comprehension—to determine whether people correctly understand what a symbol represents—can be done in more controlled environments, utilizing focus groups or surveys. This is typically undertaken only in situations where no commonly accepted single symbol standard exists, and there is a need to choose among possible alternatives or develop a new symbol.



Rental Car

Although the current standard symbol for Rental Car has been in use for over thirty years, evidence suggests that it is not universally understood. As part of a 2003 Wayfinding Study prepared for Pearson International Airport by Human Factors North, test subjects were shown the current symbol along with several alternatives (Figure 6.29). The table shows the percentage of subjects who preferred each of the four symbols tested. As this study showed, there may be alternatives worth considering for some current standards.

It is also interesting to note that, for both the current standard symbol and the most preferred symbol, the percentage of subjects who correctly identified each symbol's meaning was only around 40%.

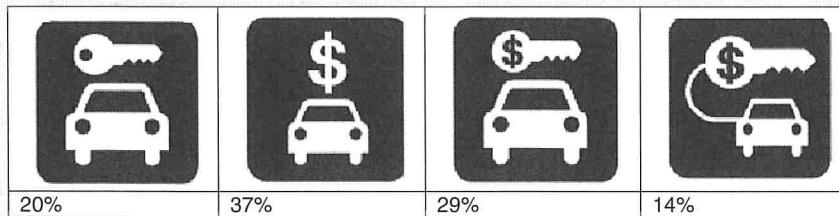


Figure 6.29. Symbols tested as part of the Rental Car case study.

A system for the systematic evaluation of symbols was developed in 1996 for the Technical Committee on Human Factors of the European Telecommunication Standards Institute (ETSI). Known as the Multiple Index Approach (MIA), this system focuses more on symbol recognition and comprehension than on simple legibility factors (detailed discussion of the MIA can be found in Section 6.5.2.9). Symbols are evaluated based on a set of indices (hit rate, false alarm rate, missing values, subjective certainty, subjective suitability, pictogram preference, pictogram set preference), with the first three being the most significant.

The Multiple Index Approach is one available tool to help evaluate a symbol's effectiveness. Given that symbol design is a creative process, and that symbols are always subject to interpretation on the part of the viewer, no guideline can guarantee the "perfect" symbol—hence the recommendation for testing.

Multiple Index Evaluation of Pictograms

Prior to carrying out a multiple index evaluation of pictogram design, participants need to receive an introduction to the questionnaire so that they understand the purpose of the study. Participants should be shown images of pictograms within the context in which they are intended to be used (i.e. context photograph illustrating how pictogram will be used). To carry out a multiple index evaluation of pictogram design, three tests are required. These are shown below:

Test 1: Test of Pictogram Associativeness. The pictogram in question is placed within a set of pictograms. Participants are given the name and associated function of the pictogram in question. Participants are then asked the following three questions:

1. Choose the appropriate pictogram for the function in question.
2. How certain is the association between the associated function and the pictogram (i.e., on a 5-point scale from "VERY UNCERTAIN" to "VERY CERTAIN")?
3. How suitable a representation is the pictogram to the intended function (i.e., on a 5-point scale from "VERY POORLY" to "VERY WELL")?

Test 2: Test of Pictogram Preference. A short description of the intended function of the pictogram is given at the top of the page and below that several pictogram design options for that function are shown. Participants are asked, "which pictogram do you think best represents <insert associated function>?"

Test 3: Test of Pictogram Set Preference. Entire sets of pictograms are presented in groups. Participants are asked, "which set of pictograms do you prefer?"

Measures:

- Hit Rate: Main parameter of performance. It is the score of the proportion of correct associations between the pictogram and associated function (Test 1).
- False Alarm Rate: Refers to the percent of time a pictogram is associated with the wrong function (Test 1).
- Missing Values: Refers to the percent of time a participant did not answer a question because they did not know the answer (Test 1).
- Subjective Certainty: Refers to how certain the participants feel in their association between pictogram and function (Test 1).

- Subjective Suitability: Refers to the subjective impression as to how well the pictogram represents the associated function (Test 1).
- Pictogram Preference: Refers to which pictogram is preferred on an aesthetic basis (Test 2).
- Pictogram Set Preference: Refers to which pictogram set is preferred on an aesthetic basis (Test 3).

Analysis:

A decision about the relative importance of each of the measures should be made before drawing conclusions from the results. Hit Rate, False Alarm Rate, and Missing Values are prime selection criteria.

6.5.2.8 Current Standards

Figure 6.30 contains the current aviation symbol standards with some updates and additions. Symbols are listed alphabetically by their most common referent name.

Some of the symbols shown here seem to be almost universally accepted; others are less so, with more observed variations in current usage.

When potential issues and conflicts related to specific symbols were identified, input from the ACRP panel and industry peer review was gathered prior to making the final symbol selection. These may relate to symbols denoting services whose meaning has evolved, symbols which may be perceived as subject to a negative interpretation, or symbols for new services.

6.5.2.9 Multiple Index Approach

The Multiple Index Approach (MIA) for the evaluation of pictograms was developed by the Technical Committee on Human Factors of the European Telecommunications Standards Institute (ETSI). It focuses on both correct associations and errors and takes into account aesthetic as well as performance parameters⁴². The following are seven MIA indices:

- The hit rate
- The false alarm rate
- Missing values
- Subjective certainty
- Subjective suitability
- Pictogram preference
- Pictogram set preference.

In most cases, performance data (hit rate, false alarm rate and missing values) will be the prime criteria.

The design of pictograms is a creative process. Currently, no design guidelines are available that guarantee that perfect pictograms will emerge from the design process—hence the need for empirical testing. The MIA is a tool for the empirical evaluation of alternative pictogram designs that provides a basis for pictogram selection at an acceptable level of comprehension. The seven indices collected through the MIA enable the evaluator to analyze the results in terms of the parameters that are important for the application at hand, be the emphasis on associativeness or on subjective and aesthetic aspects.

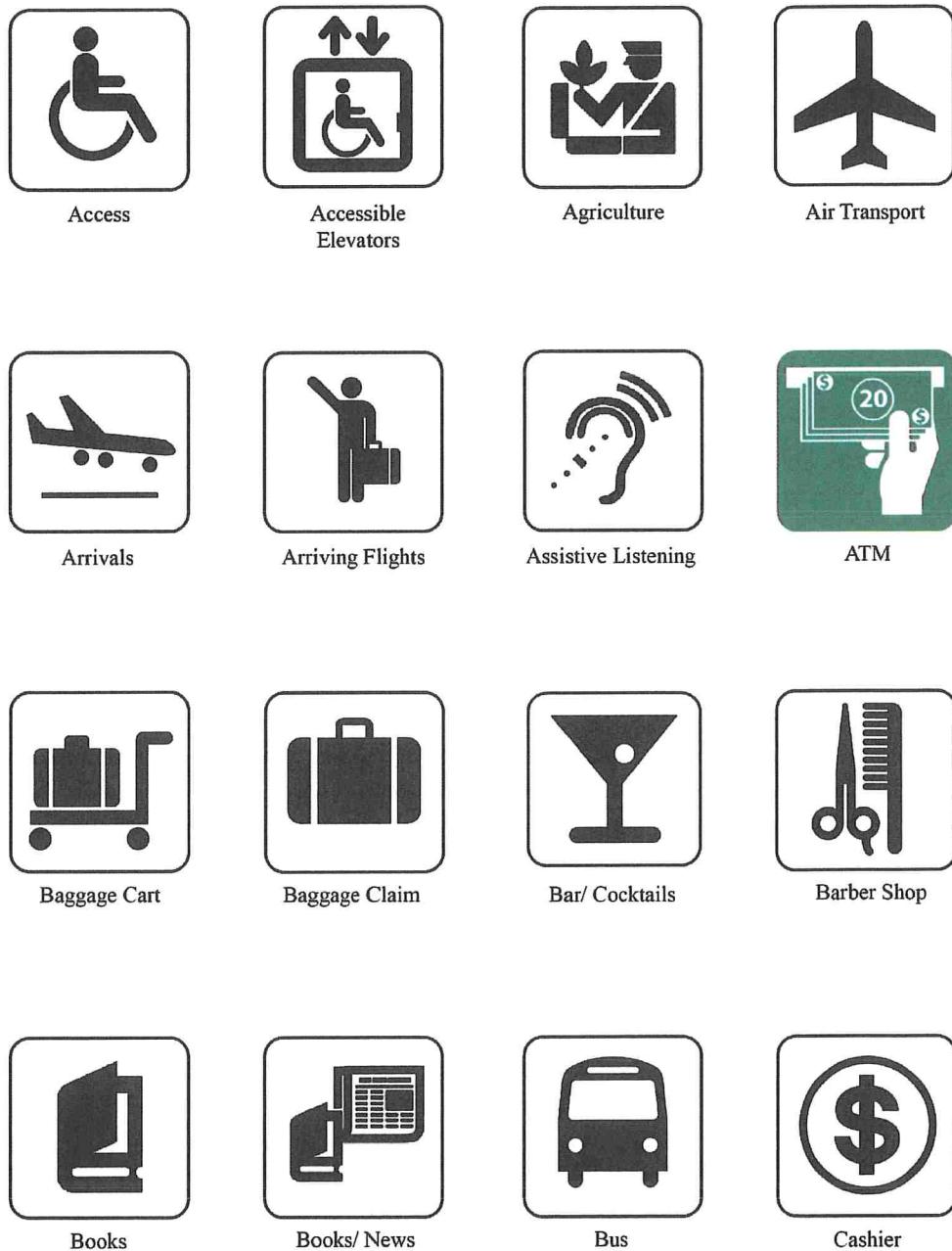


Figure 6.30. Current aviation symbol standards.

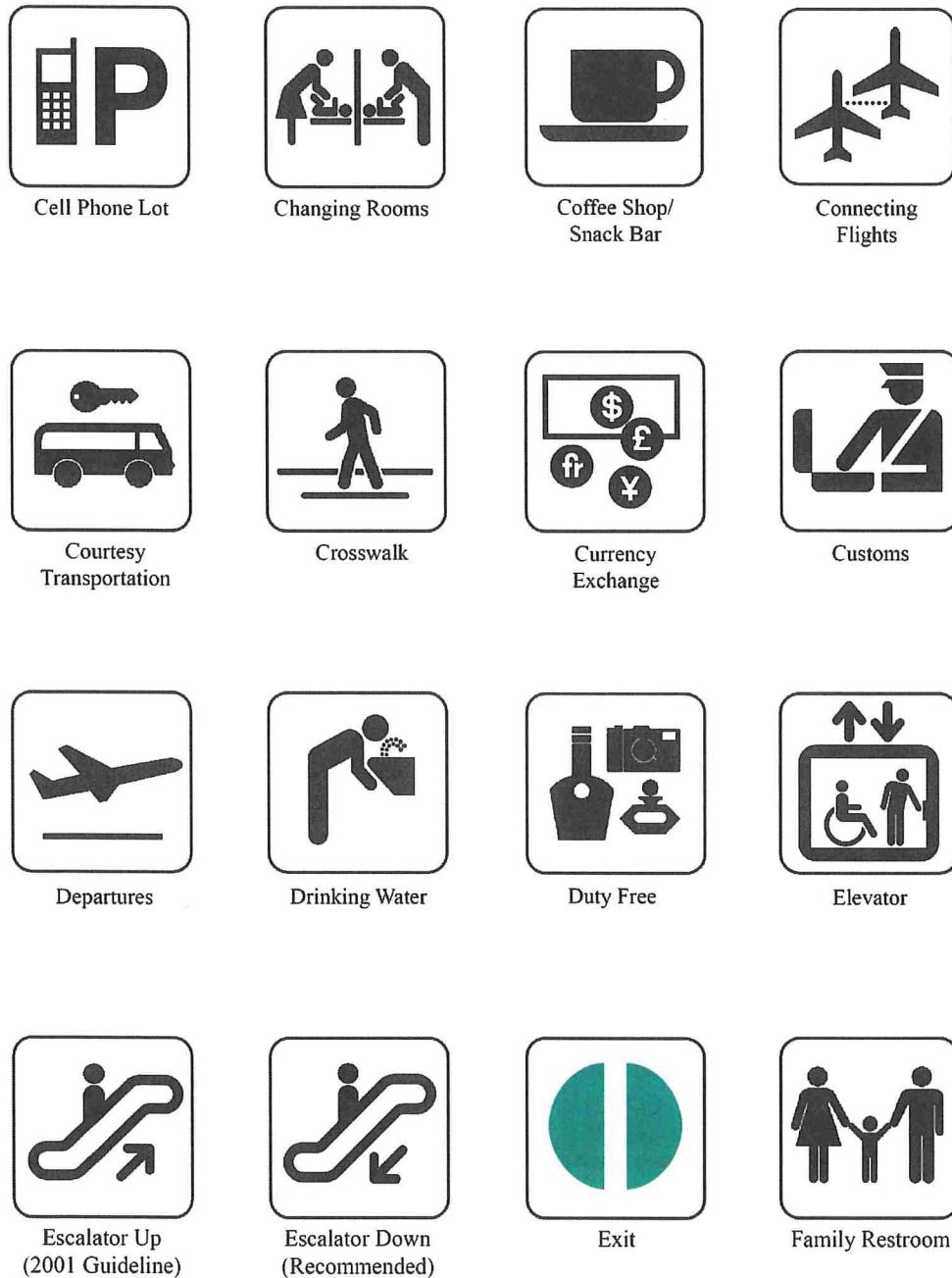


Figure 6.30. (Continued).

(continued on next page)



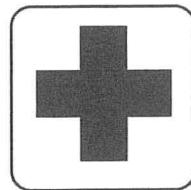
Fax



Flight Information



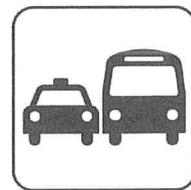
Fire Extinguisher



First Aid



Flower Shop



Ground Transportation



Heliport



Hotel Information



Ice Cream



Immigration



In Case Of Fire



Information



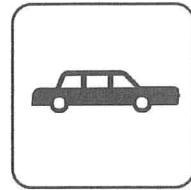
Internal Rail
Transit System
Subway/ Train



Left Luggage



Litter Disposal



Limo

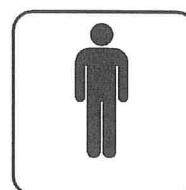
Figure 6.30. (Continued).



Lost & Found



Meditation/ Chapel



Men



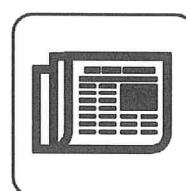
Meeter/Greeter



Military Reception



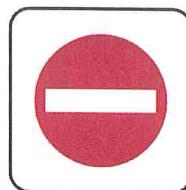
Moving Walkway



Newspaper



No Dogs



No Entry/ Do Not Enter



No Parking



No Smoking



No Weapons



Nursery



Parking



Pharmacy



Postal Facility

Figure 6.30. (Continued).

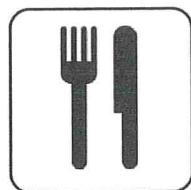
(continued on next page)



Public Health



Rental Car/ Hire



Restaurant



Restrooms / Toilets



Shoe Shine



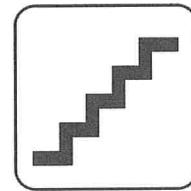
Shopping Area



Smoking Permitted



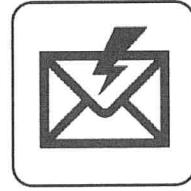
Snacks



Stairs



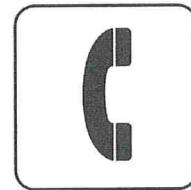
Taxi



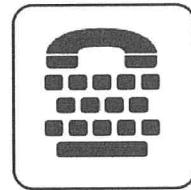
Telegraph Office



Ticket Purchase



Telephone



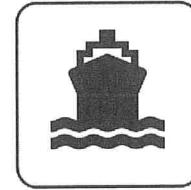
TDD / TTY



Volume Telephone



Waiting Room



Water Transport



Women

Figure 6.30. (Continued).

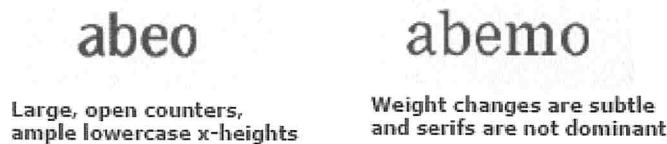


Figure 6.31. Examples illustrating aspects required for a legible typeface.

6.5.3 Typography

The goal of typography is clarity. Clarity is a combination of font selection, letter spacing, word spacing, sign layout, and contrast.

6.5.3.1 Selection Criteria

While the argument continues about whether sans serifs are easier to read than serif fonts, sans serif fonts have been proven to be slightly more legible than their serifed cousins because their letter shapes are simpler.

The following are four aspects of a legible typeface:

- Large open counters,
- Ample lowercase x-heights,
- Character shapes that are obvious and easy to recognize, and
- Fonts that are restrained.

Fonts suitable for airports are not excessively light or bold, weight changes within character strokes are subtle, and if serifs are used they do not call attention to themselves.

Counters, the white space within letters such as 'o,' 'e,' 'c,' etc., help to define a character (Figure 6.31). Typographers believe that large counters are an aid to character recognition. A byproduct of open counters is usually a large lowercase x-height. As long as the x-height is not excessively large, this can also improve legibility in a typeface. Because the majority of the letters we read are lowercase, larger letter proportions usually result in a more legible typeface (Figure 6.32).

Character width was a significant factor in legibility, with condensed sans serif performing relatively poorly and therefore not recommended. The use of multiple methodologies and qualitative research revealed clear preferences among airport users for signs with sans serif fonts⁴³.

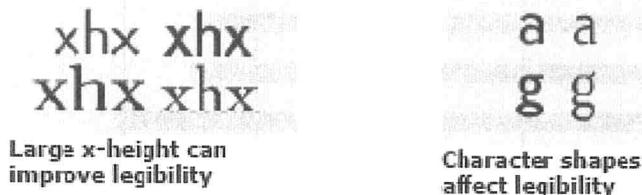


Figure 6.32. Examples illustrating preferred characteristics for legible typefaces.


CASE STUDY
Typeface Comparison

Published guidelines give ranges of anywhere from 1 inch of letter height for 25 feet of viewing distance up to one inch of letter height for each 50 feet of viewing distance. There are multiple guidelines and research on this subject to help support almost any claim within reason. For interior sign application, stating a single standard is helpful if used as a guide, but not as an absolute. One key consideration is the visual acuity of the aging population. The Snellen visual acuity chart shows how letter height is affected. The minimum requirement to obtain a valid driver's license in the United States is 20/40 vision. Legibility research indicates character width was the most significant factor in legibility, with condensed sans serif performing relatively poorly.

British Airports Authority Ltd. (BAA) funded research to compare typefaces for airport signs (Figure 6.33) using the following methodologies:

- Legibility testing, in which the recognition speed resulting from words displayed in each font was measured.
- Qualitative research, in which individuals were asked to judge the connotations and genre associations of the fonts, and express preferences for use in airport signing.
- An expert survey, in which a panel of recognized experts were asked to comment on the fonts and on other aspects of BAA's sign standards.

The average recognition speed in seconds for each font was tested (Figure 6.34). The shorter the line, the more legible the typeface. Frutiger Bold was the most legible of the fonts tested.

BAA Sign black on yellow	Frutiger Bold black on yellow	Frutiger Roman black on yellow	Vialog black on yellow	<i>Garamond Italic</i> black on yellow
BAA Sign white on black	Frutiger Bold white on black	Frutiger Roman white on black	Vialog white on black	<i>Garamond Italic</i> white on black
BAA Sign black on white	Frutiger Bold black on white	Frutiger Roman black on white	Vialog black on white	<i>Garamond Italic</i> black on white
BAA Sign white on grey	Frutiger Bold white on grey	Frutiger Roman white on grey	Vialog white on grey	<i>Garamond Italic</i> white on grey

Source: Comparing Typefaces for Airport Signs (Robert Waller 2007).

Figure 6.33. Conditions tested.

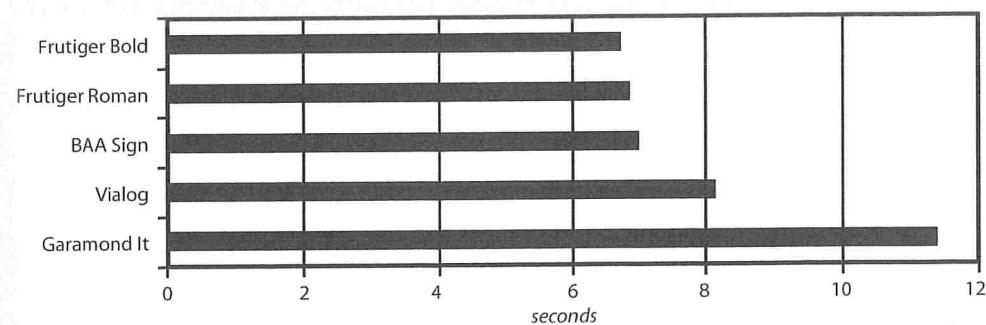


Figure 6.34. Effect of typeface on word recognition time.

Other legibility research conducted at Penn State University has provided testing that attempted to empirically determine large format distance legibility for the growing number of fonts currently available to non-transportation sign manufacturers. This study is the first to address the need to establish letter legibility for a large set of existing fonts.

This study and subsequent studies have led to adding Clearview to the family of typefaces that demonstrate superior legibility for application in airports.

Exhibit 6.3. Survey of fonts used for interior signs.

Font	Airports	Percentage
Helvetica	13	42%
Frutiger	10	32%
Clearview	2	6%
Other	4	13%
No response	2	6%
Total	31	100%

Based on current practice, the airport surveys (Exhibit 6.3) highlighted three fonts being used for interior signs. Each font shares similar characteristics: open counters, large x-heights, and consistent stroke-width ratios that all support the legibility (Figure 6.35).

6.5.3.2 Spacing

Spacing is a critical component of legibility. The following are the four parts to spacing:

- Letter spacing, a.k.a. kerning
- Word spacing within a message
- Line spacing between messages
- Relational spacing within a sign grid

Figures 6.36 through 6.40 demonstrate these four components of spacing.

Basic line spacing between words of a related message is 50% of the cap height of the letter. Basic line spacing between unrelated messages is 100% of the cap height of the letter. X equals the cap height of the letter.

Frutiger 55 Roman

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

Helvetica 55 Roman

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

Clearview

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

Figure 6.35. Fonts.

Baggage Claim _____ spacing too close

Baggage Claim _____ spacing correct

Baggage Claim _____ spacing too wide

Figure 6.36. Letter spacing examples (aka kerning).



X = Letter Cap. Height
10% Increased Kerning Shown

Figure 6.37. Word spacing example.



Figure 6.38. Line spacing examples.

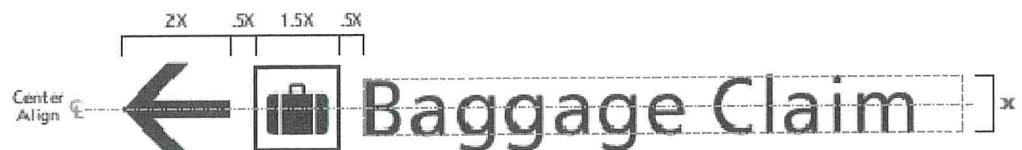


Figure 6.39. Spacing example of relationship between an arrow, symbol, and message.

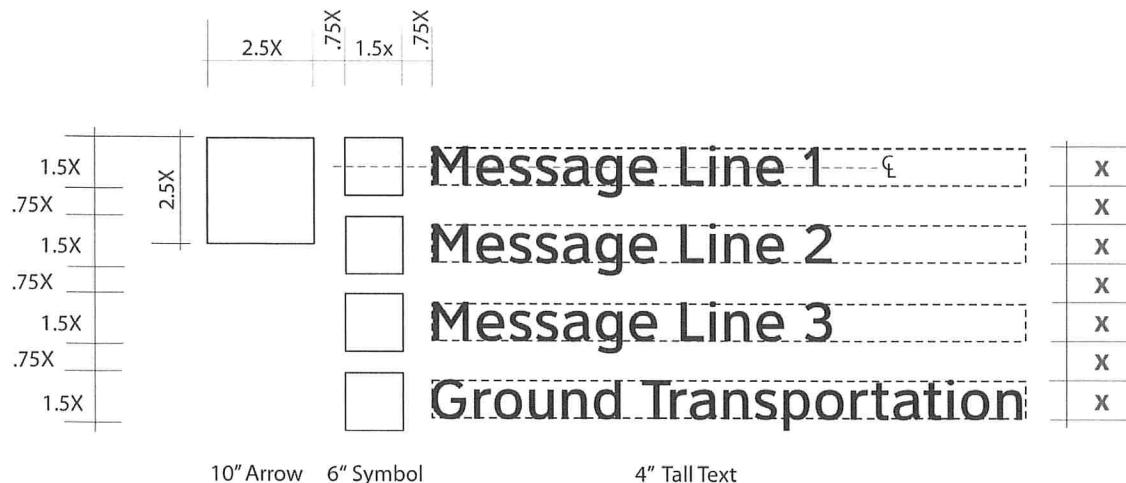


Figure 6.40. *Relational spacing within a sign grid with multiple messages, symbols and arrow. Note: When designing the sign grid take into account the longest line length of any given message. In the example above “Ground Transportation” is used to calculate the longest line length.*

CASE STUDY

Aging Population

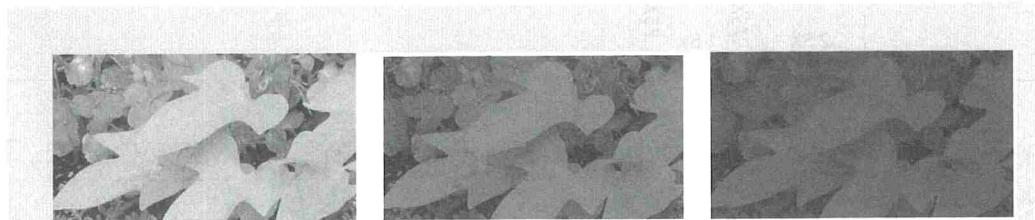
The population is rapidly aging and becoming a larger share of the marketplace⁴⁴. Thirteen percent of the population is currently over 65 years old. In 30 years that group will double to 66 million people. People change as they age. Sensory, cognitive and motor abilities decline. The built environment is not typically created with the needs of the aging population in mind. The choice of typeface in signing systems, for example, impacts the older viewer who is experiencing vision problems typical to that age group. It is important to understand that certain typefaces are more suitable to the aging eye.

Loss of light

Human vision declines with advancing age. Although there are neural losses, the major decline is due to changes in the eye's optics. The pupil shrinks, allowing less light to enter the eye. The pupil's response to dim light also decreases with age and becomes virtually nil by age 80. The elderly have especially significant vision problems in low-light environments. Figure 6.41 show how much aging changes the relative transmission of light through the optic media for viewers of ages 20, 60, and 75.

Loss of focus

The Americans with Disabilities Act (ADA) sets down body-width to height and stroke-width to height ratios for the use of appropriate typefaces in signing systems (Figure 6.42). These standards insure that more uniform typefaces are used, and that overly thick or thin stroke-widths, and overly condensed or expanded styles are not used. While these standards are an excellent starting point, it may be necessary to consider additional factors in regards to typeface selection for the aging eye.



Source: Typography and the Aging Eye: Typeface Legibility for Older Viewers with Vision Problems by Paul Nini (01.23.06)

Figure 6.41a—Age 20

6.41b—Age 60

6.41c—Age 75

Potential typeface solutions

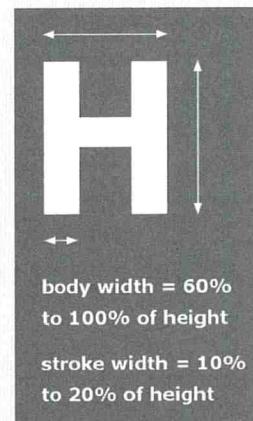
The following examples show typefaces that meet the ADA requirements for use in signing systems. Each is shown as it would be seen by a viewer with no vision problem compared with an example of how it would be seen by a viewer experiencing a loss of light and focus.

Frutiger Bold: As this face was originally created for use in an airport, it is fitting that it functions well under low vision conditions. The fairly wide proportion, open counterforms and slightly longer ascenders and descenders all seem to improve readability (Figure 6.43).

Other typefaces evaluated of note:

Futura Heavy: The simple, circular forms (such as in the single story "a" and single stroke "u") seem to hold up well under low vision conditions, as do the long ascenders and descenders. The short crossbar of the "t" does fall away, however.

Helvetica Bold: The larger x-height and wide proportions help readability under low vision conditions. The shorter ascenders and descenders do not hold up as well.



Source: Typography and the Aging Eye: Typeface Legibility for Older Viewers with Vision Problems by Paul Nini (01.23.06).

Figure 6.42. Body width = 60–100% of height; Stroke width = 10–20% of height.



Source: Typography and the Aging Eye: Typeface Legibility for Older Viewers with Vision Problems by Paul Nini (01.23.06).

Figure 6.43. Frutiger Bold still functions relatively well under low-vision conditions.

Univers 65: The slightly smaller x-height results in counterforms that close a bit more than the previous example. The wider “r” and “t” hold up well, however.

An analysis of the previous examples shows that the following visual properties could be considered beneficial for typefaces that might be viewed by older viewers:

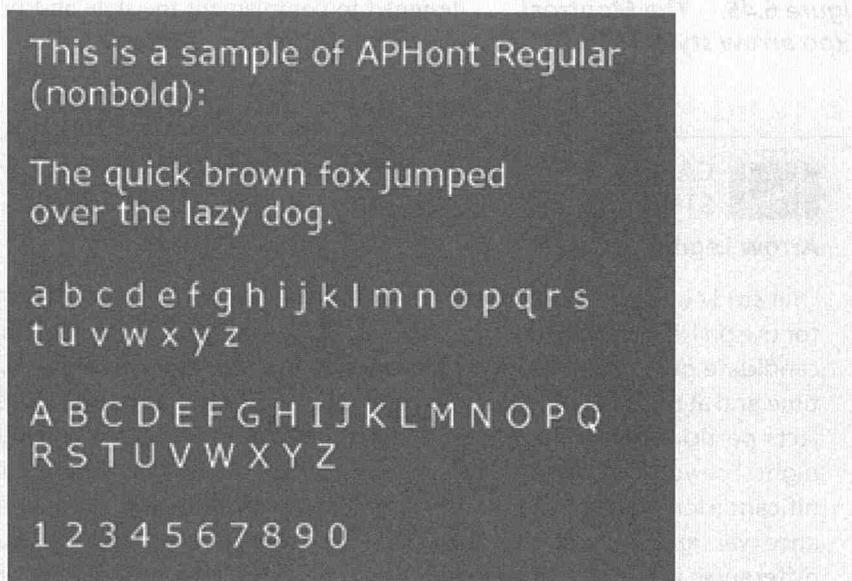
- Consistent stroke widths,
- Open counterforms,
- Pronounced ascenders and descenders,
- Wider horizontal proportions,
- More distinct forms for each character (such as tails on the lowercase letters “t” and “j”), and
- Extended horizontal strokes for certain letterforms (such as the arm of the lowercase letter “r” or the crossbar of the lowercase letter “t”).

The American Printing House for the Blind (APH) has developed a typeface known as APHont, which was specifically designed to be used by readers with vision problems (Figure 6.44). It incorporates the following:

- Consistent stroke widths,
- An under-slung “j” and “q,”
- Open counterforms, and
- Larger punctuation marks.

While APHont may not be an aesthetically pleasing typeface, it does point to the opportunity for further development of typefaces that accommodate the aging eye.

Even though many typefaces meet the requirements of the ADA, they may not all function well with the aging eye. In general, sans serif faces appear to be the most readable, due to their larger x-heights and consistent stroke widths.



Source: Typography and the Aging Eye: Typeface Legibility for Older Viewers with Vision Problems by Paul Nini (01.23.06).

Figure 6.44. APHont Regular created by the American Printing House for the Blind (APH).

Signing designers should test typeface choices prior to specification and final sign fabrication. Blurred and darkened effects can be easily created in an image editing program such as Adobe Photoshop, so digital models can be examined. As well, materials such as smoked or frosted Plexiglas can be placed in front of three-dimensional prototypes or installed signs to simulate the effects of the aging eye.

We know that for signing to function well it must display useful information, be placed at an accessible point in the space and at a proper viewing height, and be adequately illuminated. Text must be the proper size for readability from desired distances and must contrast clearly against the background. The demands of the aging eye, however, require typefaces that function well under low vision conditions. Both type designers and signing designers need to be aware of the issues surrounding common vision problems of the aging population so that the needs of this group might be better addressed in the future.

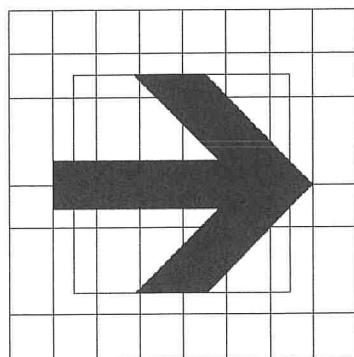


Figure 6.45. The Montreal Expo arrow style.

6.5.4 Arrows

Arrows are powerful tools. If handled properly, they can serve and protect the correct path of travel. If not, arrows can cause havoc. There are three key factors to consider:

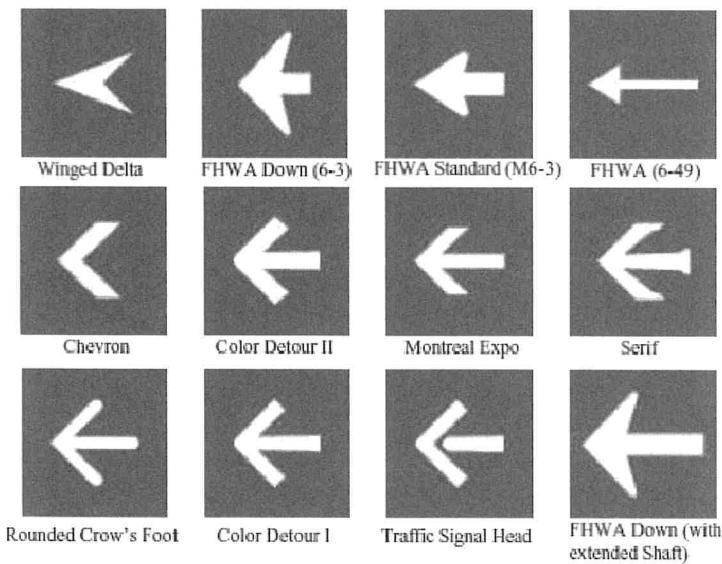
- Arrow design; which determines how legible the arrow reads.
- Arrow scale and placement in relation to the symbols, the message, or both.
- Sign placement in relation to the actual decision point

The Montreal Expo arrow in Figure 6.45 is noted to be designed to complement the style and proportions of the recommended aviation symbols.



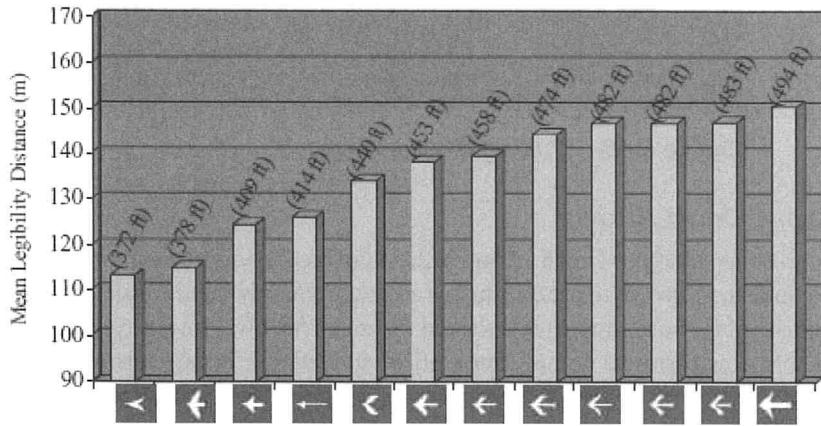
Arrow Legibility

One study was performed to evaluate a set of arrows and select the most legible for use on National Park Service (NPS) guide signs⁴⁵. The relative legibility of twelve candidate guide sign arrows was evaluated in an outdoor field study, in the daytime and at night, using older and younger observers (Figure 6.46). Forty-eight subjects participated in the daytime and thirty-two subjects viewed the arrows at night. The younger subjects were able to correctly identify arrow orientation at significantly longer distances than their older counterparts, and the daytime performance was significantly better than the nighttime. There were statistically significant differences in legibility distance among the various arrow shapes (Figure 6.47). The results show that it is possible to manipulate the legibility distance of guide sign arrows by changing their design characteristics. The arrow ultimately recommended for use on NPS guide signs, Color Detour 1, performed 18 percent better than the Federal Highway Administration "Standard Arrow" (M6-3).



Source: National Park Service and Pennsylvania Transportation Institute.

Figure 6.46. Arrow shapes used in the NPS arrow study.



Source: National Park Service and Pennsylvania Transportation Institute.

Figure 6.47. Mean legibility distances for guide sign arrow styles.

While this arrow does provide excellent legibility there are other arrow options. Based on research studies as well as the choice of typeface, there are other arrow designs that can be considered.

6.5.4.1 Arrow Scale and Placement

There is a lot of discussion and debate on arrows that point right and whether it is best to push or pull the message. Standard practice for arrows pointing right on roadway guide signs is to pull the message with the arrow being right justified (Figure 6.48). Research of current best practices also places the right arrows to the right of the message (Figure 6.49).

There is also the design issue of proportions and scale as it relates to the arrow, symbol and message. Figure 6.50 illustrates a recommended best practice of an arrow scaled from two times the cap height up to two and a half times the cap height.



Figure 6.48. Pulling the message.

6.5.4.2 Up and Down Arrows

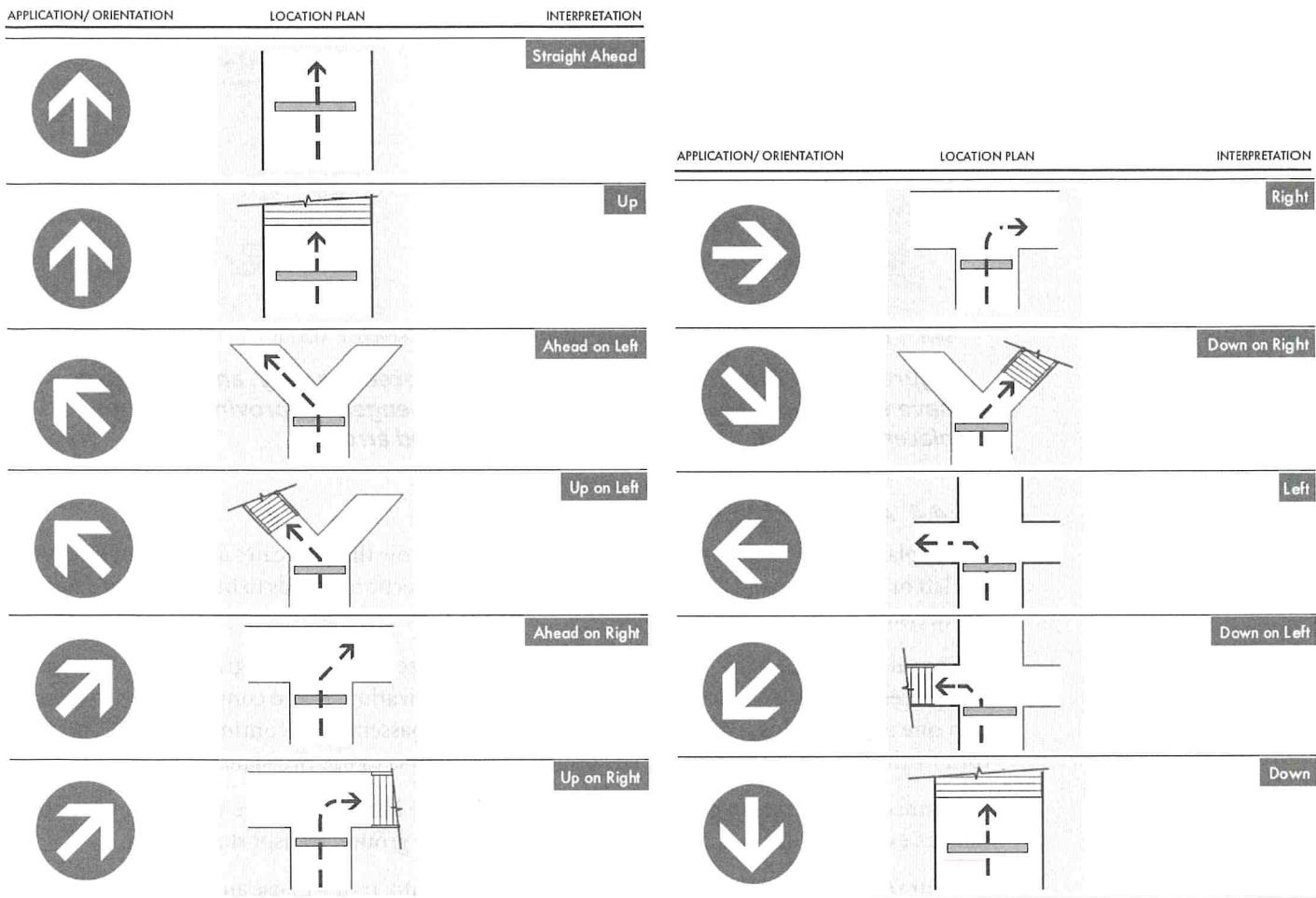
Even though either an Up or Down arrow can be construed to indicate a forward movement it is important to understand when to use each arrow and then to apply them consistently (Figure 6.51). The vast majority of forward movements should use an Up arrow. However, there are exceptions where the use of a down arrow is needed. The vertical circulation in airport terminal design can vary greatly so a comprehensive evaluation is necessary in order to identify the types of decisions points associated with each vertical transition. It is not practical to illustrate every condition, but the following illustrations will help to understand when using a down arrow is acceptable.

6.5.4.3 Angled Arrows

Arrows placed on an angle have the potential to create more confusion for passengers than any other arrow for multiple reasons. Depending on the passenger's point of view it may not always be clear exactly what the angled arrow is pointing to.

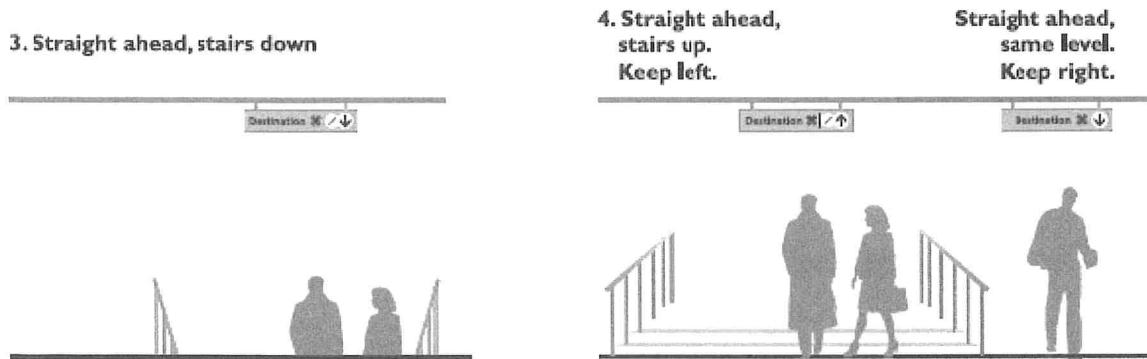


Figure 6.49. Pushing the message.



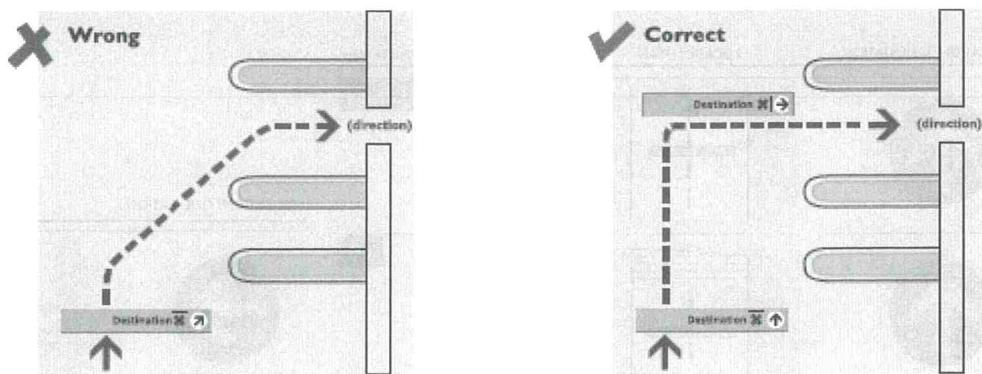
Source: Boston Logan International Airport "Signage Standards and Guidelines Volume 1 - Terminals," July 2005.

Figure 6.50. Example of arrow applications that illustrates the best practices for typical sign location conditions.



Source: The Port Authority of NY & NJ Signing and Wayfinding Airport Standards Manual.

Figure 6.51. In certain circumstances, an arrow pointing down, indicating 'straight ahead,' can be used when there is an upwards vertical circulation nearby.



Source: The Port Authority of NY & NJ Signing and Wayfinding Airport Standards Manual.

Figure 6.52. When a directional sign is not placed properly, angled arrows have the potential to create confusion for passengers. Improving the sign placement can eliminate the need to use angled arrows.

6.5.4.4 Arrows with Regard to Sign Placement

The placement of a directional sign is critical to an arrow that indicates a change of direction; e.g. left or right. To avoid any potential confusion the directional needs to be located on axis with the decision point.

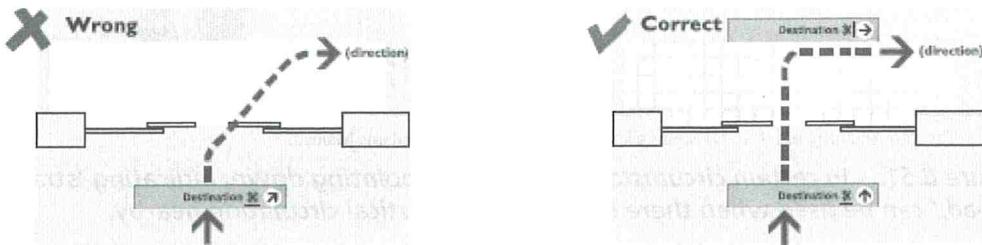
Consider other design options that will enable the use of a ninety degree arrow. Emphasize sign placement to eliminate any confusion of arrow application. Avoid combining two decisions into one sign by using a 45 degree angled arrow for a passenger to continue straight and then turn further ahead (Figure 6.52). The preferred solution is to use two signs.

Figure 6.53 illustrates a good example of this principle in airports at the vestibules where passengers exit from the baggage claim area to the curbside ground transportation area.

Figure 6.52 and 6.53 demonstrate an easy trap to fall into: trying to use an existing sign to indicate a decision point past the sign. This sign may be an existing condition and relocating it may cost more money. The prospect of adding a second sign may be even more expensive. However, the indirect cost of not signing a route correctly is confused or lost passengers. Direct costs can be attributed to passengers who have a positive wayfinding experience will be confident in taking time to shop; while passenger that are lost and confused will worry about missing their flight more than shopping. This philosophy goes directly back to Step One that is outlined in developing a wayfinding strategy and the concept of positive guidance.

6.5.5 Color

It has been noted that approximately 12 percent of the population is colorblind and cannot distinguish between mixed shades of yellow, orange, red and brown or black, blue and green. The



Source: The Port Authority of NY & NJ Signing and Wayfinding Airport Standards Manual.

Figure 6.53. Two signs with an up and right arrow are preferred to one sign with an angled arrow.

Exhibit 6.4. Survey of airports about their use of colors on terminal signs.

Single primary background color	20	65%
Color coding used to identify destinations	7	23%
Other*	3	10%
No response	1	3%
Total	31	100%

*“Other” included:

- a. Black background, white text, vertical color stripe - color coded for each terminal
- b. Color code for: Departures

Survey data collected shows only 23 percent of airports use color as part of their wayfinding system. The majority of airports surveyed use a single primary color. Airports were asked about their use of colors on terminal signs. Exhibit 6.4 shows the results of this survey.

The survey data from the majority of design professionals indicates that color can be used effectively in wayfinding as a secondary support element. Color difference used alone as the primary wayfinding element is not necessarily effective. Color combinations should be chosen carefully with light reflectance values in mind and certain color combinations should be avoided.

Considerations for airports using a single primary color:

- Reserve the single sign color application for wayfinding only to provide focus and clarity to the wayfinding components by not having to compete with surrounding visual elements.

Considerations for airports using color coding as a wayfinding device:

- Color coding can be used as a design element to support wayfinding but not as the primary wayfinding device.

Applications from airports that indicated use of a color coding system:

- Yellow is for flying activities (ticketing, gates, etc), green is landing (parking, ground transportation, etc), black is for services (restrooms, elevators, etc).
- Limited use of color to designate arrivals and departures.
- Each terminal has its own specific color.
- A yellow border is used to highlight the alpha terminal identifiers icons.

Amsterdam's Schiphol International Airport, Newark, Port Columbus and JFK, utilize three sign background colors to differentiate between three primary airport function groupings:

- Yellow—flight services,
- Green—leaving the airport, and
- Black—auxiliary services.

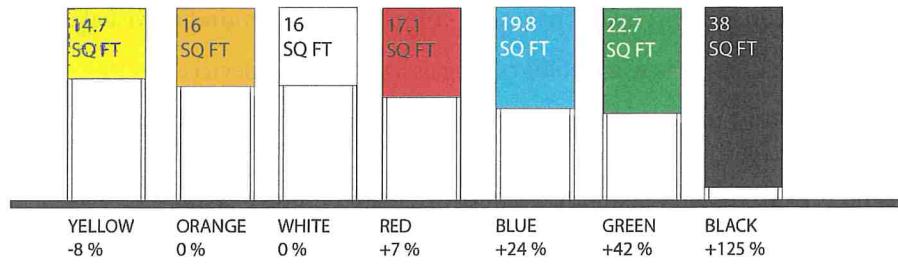
While this particular color coding system does not contain any explanation to passengers of logic behind the color coding, proponents of this approach claim passengers find the information they need more quickly and efficiently (Figure 6.54).

Other factors to consider—Color conspicuity can be explained as, “How well does a color stand out from its surroundings?” Lighter colors tend to advance towards you and darker colors tend to recede into the background. The eye also reads some colors quicker than others. The combination of this information has functional value in the design of a sign system (Figure 6.55).

Color contrast also plays a primary role in sign design. An article on Effective Color Contrast⁶³ published by Lighthouse International looks at the three perceptual attributes of color—hue, lightness and saturation. The color wheel in Figure 6.56 shows why contrasting hues from adjacent parts of the hue circle should be avoided.

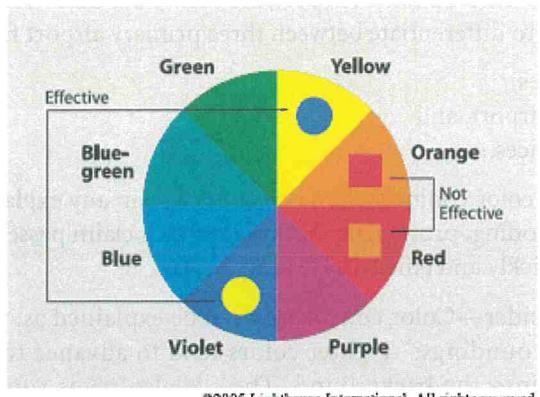


Figure 6.54. Three primary color system currently used by several major airports.



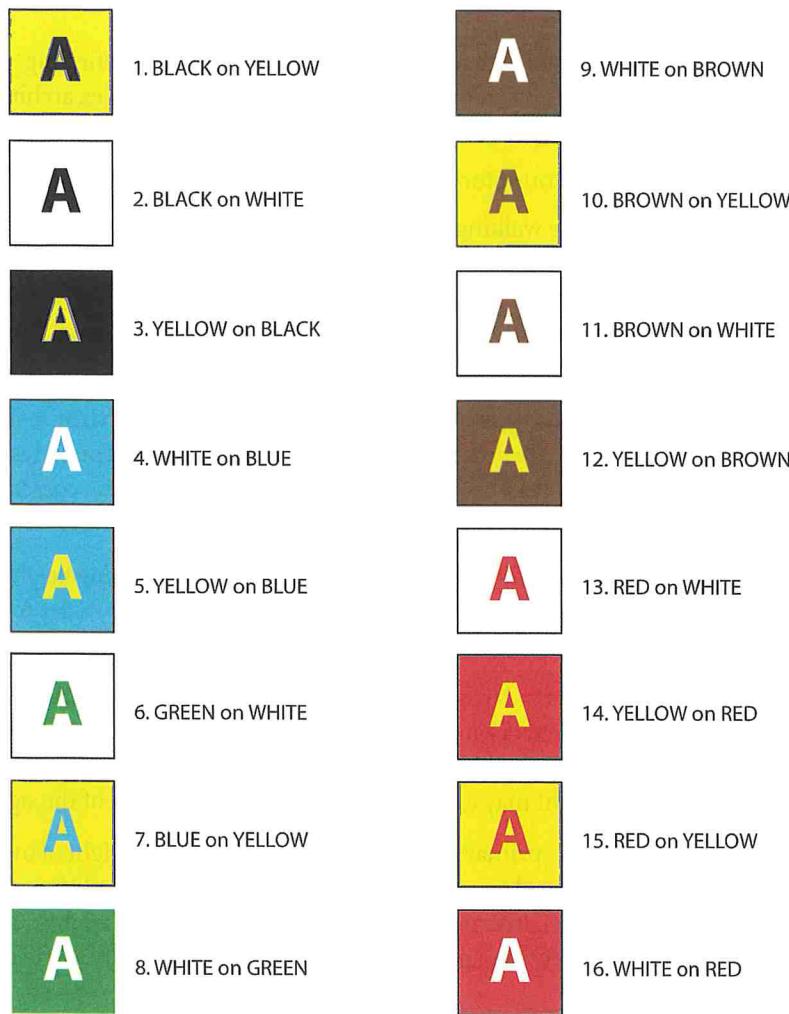
Source: The Sign Users Guide, Copyright 1988, by James Claus and Karen E. Claus and Sign of the Times Publishing Company.

Figure 6.55. The percentage of area a colored sign has to exceed a white sign to be equally conspicuous is shown here.



Source: Copyright 2005 - Lighthouse International.

Figure 6.56. Examples of which contrasting hues from adjacent parts of the hue circle should be avoided.



Source: Claus, K.E. and Claus R.J. *Visual Communication Through Signage, Vol. 1: Perception of the Message*, Cincinnati, Ohio, Signs of the Times Publishing Co., 1974

*Atmospheric and ambient light conditions as well as type of letter may affect the legibility of color combinations listed.

Figure 6.57. Best color combinations used in lettering of outdoor advertising displays ranked in order of legibility of letters from a distance.

Figure 6.57 illustrates the most legible color combinations. These illustrations can be used as a guide of color conspicuity and contrast. Airports and designers can leverage this knowledge to achieve superior legibility results.

6.6 Sign Locations, Data Bases, Illumination, Materials, and Safety

6.6.1 Sign Locations

There have been several preceding sections that have touched on the importance of directional sign locations. This section will provide additional information starting with the basics.

Good features of directional signs include the following:

- Consistency of highly visible suspended signs viewable from a great distance;
- Signs located in the center of the flow and not to the side; and
- Signs perpendicular, rather than parallel, to the flow.

6.6.1.1 Sign Frequency

Philosophically the fewer signs the better because it helps simplify the wayfinding, reduce visual clutter, and it also helps reduce the cost of the sign system. However, a complex architectural space may require additional signs to compensate for the lack in a building's intuitive wayfinding design.

Reasons for adding signs to account for other users include the following:

- In the concourse, not just those walking down it
- Coming out of restrooms
- Coming out of a concession area
- And especially those arriving on a flight that need confirmation of which way to go

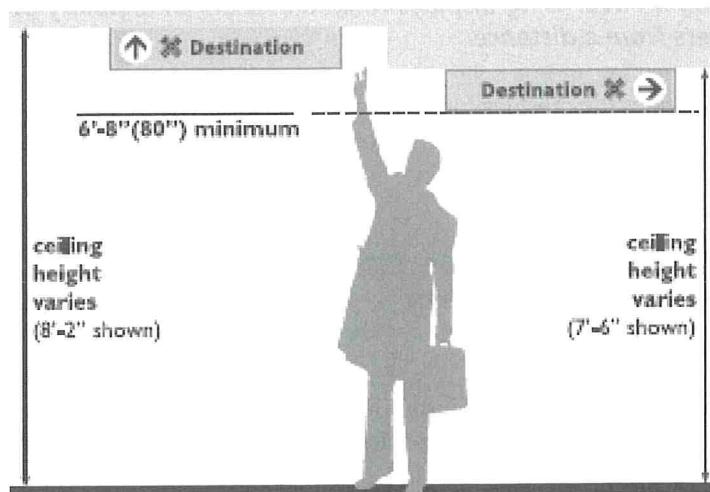
The goal is to be as consistent as possible and still use the same frequency because it is expected, especially for long corridors that may pass through visually busy graphic environments, then further down are not so busy. If there are no key decision points along a given route, research results indicate signs should be added to reassure the passenger they are still on the correct path. Consider placing these reassurance signs every 150 to 250 feet³⁹.

Mounting height. The airport architecture ultimately dictates the mounting height of the overhead directional signs so it is important to survey the varying conditions in order to determine a consistent mounting height for these sign types as well as identify exceptions such as low ceilings.

The minimum height per ADA standards for overhead signs is 6'-8" (Figure 6.58). However, this mounting height should only be used because of very low ceiling conditions. The survey of current airport practices indicates a recommended minimum height of 8'-0". In large open architectural spaces with high ceilings, this height may extend up to 10'-0" to the bottom of the sign.

Regardless of the conditions, the primary consideration for mounting height of overhead signs is consistency. During the planning phase, take inventory of the existing conditions (or reference the reflected ceiling plans for new construction) to document the ceiling heights. Compare this information to establish a consistent sign mounting height as well as identify any exceptions that need to be accounted for.

The process of determining a consistent sign mounting height should also establish dedicated zones for wayfinding information versus advertising, artwork, etc.



Source: The Port Authority of NY & NJ Signing and Wayfinding Airport Standards Manual.

Figure 6.58. The minimum height per ADA standards for overhead signs is 6'-8", which should only be used because of very low ceiling conditions.

6.6.1.2 Information Zones—Other Graphic Elements and the Avoidance of Sign Clutter

The goal to eliminate visual clutter in an airport can be achieved with a concerted effort to organize messages into fewer and more purposeful sign placement. Researchers note the challenges of key wayfinding elements having to compete with other visual stimuli on several levels. Other than basic statements noting the need to establish visual access with clear sight lines, there is little documented research regarding sign placement in airport terminals. The information for this section draws from documented best practices and case studies. The following narrative and illustrations are representative.

The first challenge is simply competing for space. Art and advertising are the more common sources competing for the same valuable space. The non-airline revenue generated by advertising can make this competition for space even more adversarial.

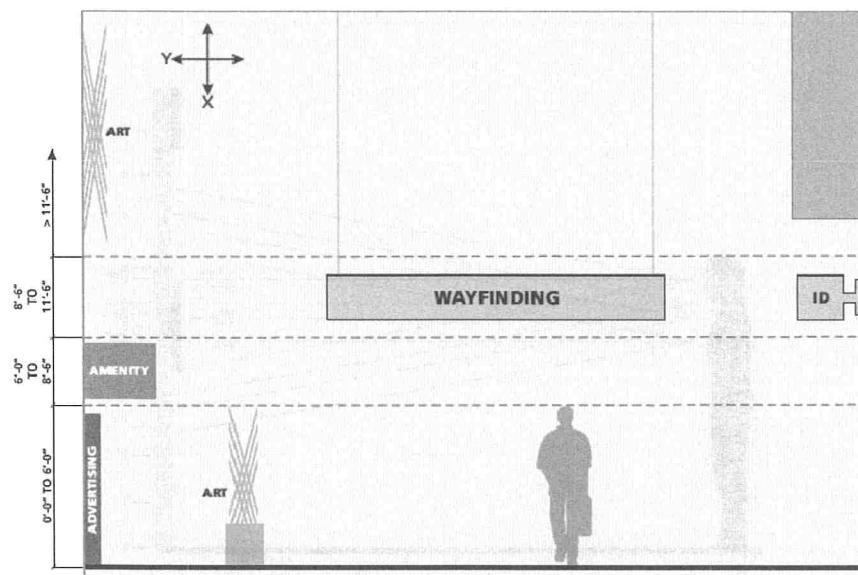
The other challenge is the visual onslaught that competes with the wayfinding for the passenger's attention. By establishing vertical and horizontal spaces that are clear of competing elements an airport can control the foreground and background by creating wayfinding information zones. The result is a more positive passenger wayfinding experience.

Figures 6.59 and 6.60 show how this concept works by applying the wayfinding information zone inside the building envelope.

6.6.1.3 Wall-Mounted Signs

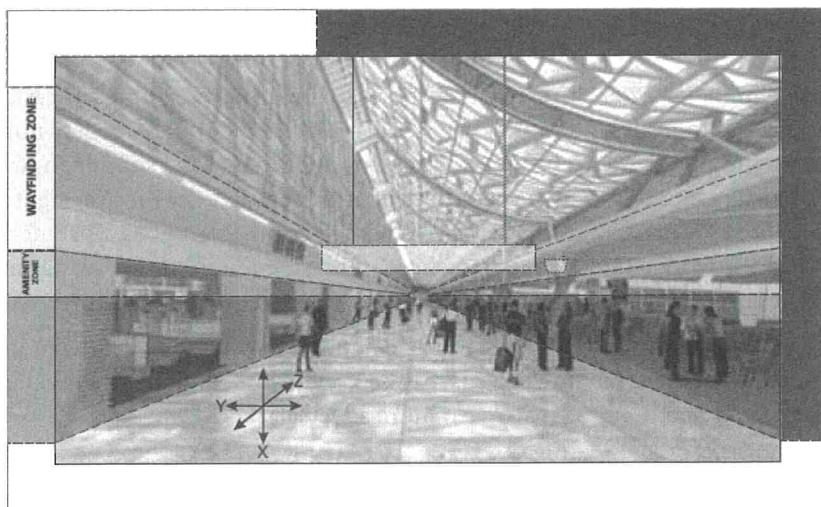
While wall-mounted signs are subject to ADA guidelines, it is important to recognize the human factors that apply to the viewing angles.

The mounting heights of the 95th and 5th percentile of men and women (95m, 5m, 95w, 5w) with respect to vertical sign location are demonstrated in Figure 6.61. The mounting heights shown ($\pm 10^\circ$ from line of sight) represent the area that can be viewed without eye movement. The position of signing at 5-feet, 7-inches is within this mounting height for approximately 95% of the population. The signs that fall into this category are: restroom identification plaques, room (number) identification signs, elevator warning signs, door-mounted "do not enter" signs, and other regulatory and code required signs.



Source: Mineta San Jose International Airport.

Figure 6.59. Typical example from SJC of the X axis wayfinding information zone.



Source: Mineta San Jose International Airport.

Figure 6.60. Typical view inside SJC.

The mounting heights of a seated person and users in wheelchairs, with respect to the 10° viewing angle from the line of sight are demonstrated in Figure 6.62. Smaller identification, information and regulatory signs should be wall or door-mounted at an elevation between 5 and 6 feet. These show viewing ranges (10° from line of sight) that represent the area that can be viewed without eye movement. This data is accurate for approximately 95% of the population. All signs must conform to the Americans with Disabilities Act (ADA).

6.6.2 Information Databases

Creating an information database to manage an airport's wayfinding system is important to help perpetuate the value of the investment. A typical data base consists of the following three parts:

- Sign location plans—show where each sign is located either on site plan or architectural floor plan
- Message schedule—lists the message for each sign along with the sign type
- Sign type illustrations and or photos—indicates sign construction details and information

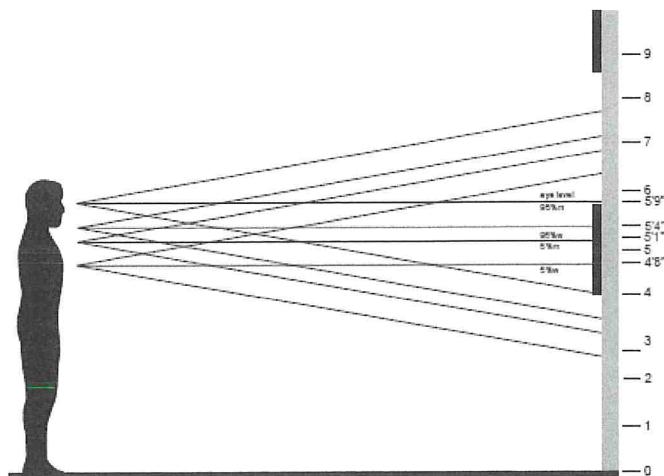


Figure 6.61. The mounting heights of the 95th and 5th percentile of men and women with respect to vertical sign location.

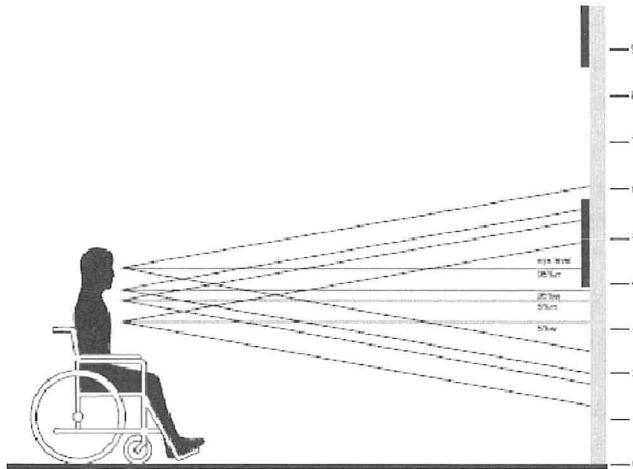


Figure 6.62. The mounting heights of a seated person and users in wheelchairs, with respect to the 10° viewing angle from the line of sight.

Creating an information database can require a substantial amount of time and effort. Whether an airport chooses to create their own database or work through an outside consultant, the first step is to understand how the airport uses data base information. Therefore, to make sure the airport's resources are well utilized an airport must determine the following:

- What is the mission? Define what the data base will help accomplish. For example:
 - Changes—Know which signs are impacted by an airline change. The list can include signs on the roadway, curbside and terminal
 - Maintenance—Know which signs require regularly scheduled maintenance or inspection so work orders can be easily generated and tracked.
- Who will have access? This can be anyone from airport operations to airport planning.
- Who will be responsible for keeping the database up to date? Without a designated 'gate-keeper' the data base will quickly become obsolete and the resources spent creating the data base will be lost.
- How does the airport track other systems and locate them either outside on the roadway or inside the terminal?
- How will the sign information be tracked for common-use space versus tenant spaces?

Other key considerations:

- Incorporate graphic standards as part of the data base for easy reference for staff that has access.
- Develop the logic for the sign numbering system with a beginning and an end. In other words the sign location numbers continue from sheet to sheet to provide a unique sign number for each location.
- Consider adding a prefix or suffix to the sign location number to help indicate where the sign is on the airport.
- Include a logic for how new signs are added to the sign location plan and the message schedule. One method is to use the number of the closest sign and add a suffix. This symbiotic method of organizing the sign locations in a relative sequence will help later on when trying to locate the new sign number on a plan.
- Consider how the data base software can be tailored to address maintenance issues in a proactive versus a reactive manner. This can include ticklers/reminders for scheduled maintenance or inspections that can help prolong the effective life cycle. It can also list specifications for lamping and ballast for servicing illuminated signs.

- A data base can include either an illustration or a photo of each sign with dimensions, materials, colors, etc.
- A data base should include a key word search function to help facilitate message changes.
- Include a key plan on every sign location plan drawing

A data base for the airport's sign system can be generated in either one of two ways. An existing airport facility will require a physical inventory. A database for new construction can be generated from the contractor's as built drawings. Both methods are valid means to create a sign system data base.

The last point to consider is the most important and is worth repeating: how will the data base be maintained? It is a living, breathing document and an airport must make a realistic evaluation on what kind of commitment and resources can be made to keeping this data base up to date. Set a minimum standard for updating the data base regularly; a good target is annually. A cost effective method is using interns to inventory and update the data base. Another method is to implement an on-call service contract to update the data base.

6.6.3 Illumination

A study by Carnegie Mellon University researchers emphasizes the key role that new lighting technologies—specifically LED technology—play in promoting energy efficiency and helping reduce the emission of greenhouse gases.

“Technology and innovation in the area of lighting has quickly become a vital aspect of the broader movement toward increased energy efficiency and responsible use of global resources,” said Granger Morgan, professor and head of the Department of Engineering and Public Policy (EEP), and a member of the National Academy of Science. Another important note is that unlike the fluorescent tubes they replace, solid-state lighting is mercury-free.

Lighting plays a vital role in the effectiveness of an airport's wayfinding system, but understanding the options and determining what lighting solution will work best in a given airport is a challenge that requires a certain level of expertise.

The process on how to evaluate an airport's needs and select the proper lighting for a given airport space begins with the basic decision of illuminated versus ambient light.

There is little debate that internally illuminated directional and informational signs provide a higher level of visibility. This is supported by research that indicates passengers perceive a higher LOS at airports with internally illuminated signs. However, the literature did not provide any measured research with quantitative proof that passengers actually experienced an increase in wayfinding performance.

Therefore, an airport must decide if the added expense of installing and maintaining an illuminated sign system is justified as being a superior wayfinding system compared to a sign system that is not internally illuminated.

Cost comparisons for illuminated signs include two factors—initial installation costs and the ongoing long-term cost. Depending on the actual sign design, an internally illuminated sign can cost 50% to 100% more than a comparable non-illuminated sign. In addition to the added cost of the light source, ballast, and transformers, the initial installation must also factor into the cost of the electrical service to each sign in order to understand the true total of the initial installation cost.

The three basic types of illuminated signs are:

- Internal illumination of the entire sign face (Figure 6.63a).
- Internal illumination of the text only with an opaque sign background (Figure 6.63b).
- External illumination that washes the sign face (Figure 6.64).



Figure 6.63a. Internal illumination of the entire face.



Figure 6.63b. Internal illumination of text only.

Choosing either method of internal illumination will require special attention be given to the design of the sign face to facilitate future message changes.

Other factors to consider when evaluating what type of lighting to use:

- The overall ambient light levels maintained inside the airport (daytime and nighttime).
- The maintenance and cost issues of making message changes to the sign face and how those costs are budgeted.

Many airports successfully use the ambient lighting inside the airport to provide the necessary visibility for the wayfinding signs, which is an acceptable alternative (Figure 6.65).

The benefits of using ambient light are:

- Lower front end cost to implement,
- Lower cost to maintain, and
- Typically easier and less expensive to make inevitable messaging changes.

Regardless of what illumination method is used, the illumination levels on the sign surface shall be uniform over the sign surface. It is also important to consider the location of signs so they are located such that the illumination level on the surface of the sign is not significantly exceeded by the ambient light or visible bright lighting source behind or in front of the sign.



Figure 6.64. Avoid glare that creates hotspots when using external illumination that washes the sign face.



Figure 6.65. Examples of signs using ambient lighting.

CASE STUDY

LED Lighting

The following case study was developed in 2009 by the Salt Lake City Department of Airports as part of their internal evaluation process of comparing the costs of fluorescent versus LED internal illumination⁴⁶. The process outlined in this case study is a good example for an airport to follow.

1. Set goals of LED sign lighting project for Salt Lake City International Airport
 - a. Reduce operating costs by:
 - i. Reducing energy consumption.
 - ii. Reducing maintenance cost by reducing frequency of scheduled maintenance and also reducing damage to sign fixtures due to same reduction in maintenance frequency.
 - iii. Eliminating toxic chemicals found in existing lighting thus saving money on expensive waste disposal.
 - b. Improve sign visibility and legibility by:
 - i. Using more even illumination with less hot spotting and more well defined text due to less light bleeding caused by existing light source
2. Product selection process
 - a. Testing
 - i. Construction of typical lighted sign boxes to be used in bench testing several different brands of LED lighting.
 - ii. By installing each type of LED lighting in our test boxes instant side-by-side visual comparisons of light color were obtained. Using a common light meter the light output was measured for evenness of illumination.
 - iii. Side-by-side comparisons also assessed ease of installation and material costs
 - iv. Over a 6-month timeframe, periodic measurements were taken of light output to assess possible light loss, degradation of color, or other undesirable anomalies. Power consumption was also measured.

b. Challenges

- i. Because of the fast paced evolution of the LED industry, there had been little testing at this time to come up with uniform standards for the LED lighting industry. This resulted in a lot of homework to evaluate the LED manufacturers.
- ii. Writing exacting specifications for the procurement process was also difficult because of the lack of uniform measurements and testing in the industry, thus a lengthy bench testing became invaluable.
- iii. Illuminating double-faced signs without hot spots was difficult. The further you can place the face of the sign from the light source, the more even the illumination. The research at this time did not find LED lighting fixtures that had 360 degree illumination (similar to fluorescent tube). This resulted in mounting the LED fixtures on the top and bottom of the sign boxes and relying on reflected light to fill into the center. On boxes taller than 20" the center of the signs were unacceptably darker.

c. Comparison analysis/metrics between existing and new LEDs

- i. Initial implementation costs: for 72 signs with existing fluorescent/\$18,504. LED/\$52,000 for 72 signs minus \$12,000 for the local electrical utility rebates= total LED installation costs of \$40,000.
- ii. Power savings of \$36,292 during the LEDs 50,000 hour life span versus existing fluorescent.
- iii. Maintenance cost savings of \$27,360 (estimated) over the 50,000 hour (warrantied) life span of LED lamps versus existing fluorescent. Fluorescent hazardous material recycling savings: \$1,599 over the 50,000-hour life span of the LEDs.
- iv. Quality of light/Photometric: the LED lamps run 5,000 Kelvin. As of this writing, the LED lamps have had less than 2% loss of lumen output.

3. Summary

- a. Findings: The findings are not considered conclusive as the new signs are only 1.5 years into the proposed 5.5 year life span of the LED lamps, however the 5,000 kelvin in the LEDs provide noticeably improved readability on our illuminated signs (better text definition/less light bleedover, easier to read at distance) than the existing 3,000 to 4,000 kelvin fluorescent. There is also a much smoother illumination with far less hot spotting.
- b. Recommendations: Highly recommend finding a supplier/manufacturer with an experienced R&D staff close to your facility (if possible) that would be willing to help design the correct system for your application. Off the shelf products can be difficult to make work in many retrofit applications.
- c. Lessons learned: Continued research for future LED lighting projects using double faced signs taller than 20", has developed (with the help of the local lighting supplier) an LED lamp with the same 360 degree illumination of the fluorescent tube, that will be used on the next lighting retrofit project.
- d. Ongoing methods for documenting metrics: Continue to take lumen readings on predetermined signs at the exact same face locations of the current LED signs to check for light degradation. After eighteen months into the warranty period there has been approximately 2 to 5% light loss with no visible color shift.

6.6.4 Materials

The world has developed a conscience and sustainable design through the use of renewable and environmentally friendly materials, and this has become the new standard for the design industry. During the design phase, the materials and products being considered for the project: metals, woods, plastics, paints, adhesives are reviewed to see if they fit into a sustainable design philosophy.

There is not one standard for evaluating the sustainable characteristics of all building materials. There are some tools that can be used, however, when selecting materials, at least in part, due to their sustainable characteristics. They include:

- National Institute of Standards and Technology Building for Economic and Environmental Sustainability (BEES). BEES measures the environmental performance of building products by using the environmental life-cycle assessment approach specified in ISO 14000 standards
- American Institute of Architects's (AIA) Environmental Resource Guide. This guide presents detailed life-cycle information about a number of building products.
- LEED Material Credits. The material credit requirements in the LEED Green Building Rating System address some of the key criteria for product selection.

The following is a checklist for determining if a material is “green.” Is the material:

- Low embodied energy,
- Recyclable,
- Renewable,
- Locally or regionally produced,
- Energy efficient,
- Low environmental impact,
- Durable,
- Minimizes waste,
- Positive social impact, and
- Affordable.

Sign maintenance is addressed in Section 6.7, but it is worth noting here that combinations of the materials selected directly impact the time, effort, and cost associated with making changes that are inevitable. Therefore, review the process and expense involved to make message changes to either current or proposed materials.

Evaluating a material, or comparing two materials to determine if the product(s) is a sound environmental product depends on the evaluation of a material's life cycle, often called the cradle-to-cradle analysis of a material. This process typically addresses the environmental impacts of the following:

- Resource acquisition. This includes addressing the environmental impacts of extracting the resources necessary to manufacture the product.
- Manufacturing. This includes evaluating the environmental impacts of the manufacturing process.
- Transporting. This includes considering the impacts of transporting the material to the manufacturing or assembly location, as well as transporting the material to the site.
- Installation. This includes considering the impact the installation of the product will have on the installer as well as any building occupants.
- Impact to Building Occupants. This includes evaluating what impact the product will have on occupants during its use.
- Performance. This includes considering how durable the product is, as well as what kind of maintenance requirements the product has.
- End of use options. This includes considering if the product can be disassembled, recycled, or reused.

6.6.5 Mounting

Mounting of signs can be synonymous with sign location in that they both relate to placement: vertical, horizontal, as well as in a plan view. The primary difference of mounting is the method used to physically install the sign. There are three primary categories:

- Overhead: Signs that are either suspended from the ceiling, mounted flush with the ceiling, or are located on an architectural soffit or wall.
- Freestanding: Signs that have their bases mounted directly to the floor surface using a mechanical fastening system.
- Wall: Signs that are mounted with the back of the sign to the wall using either an adhesive or mechanical fastening system.

It is very rare that one mounting method will meet all installation conditions in a given airport. Therefore, in order to present the wayfinding information in as consistent manner as possible it is important to consider the variations in the architectural conditions when planning an airport's sign system. If the directional signs are illuminated, the mounting method must also consider the need to provide electrical service and make the necessary allowances. See Appendix D for detailed illustrations with recommended clearances for these various sign types.

6.6.6 Safety

Passenger safety is always a priority. Many of the safety issues are already addressed by code requirements, so it is not the purpose of this guideline to review each safety related condition and applicable codes. Airports should use available resources to research the codes associated with safety issues based on the AHJ (Authorities Having Jurisdiction).

The airport surveys provided the following responses when asked about safety-related sign and wayfinding issues at the terminal:

- Escalator signing is always an issue—tendency is to add more signs.
- Signs for emergency exits, defibrillators, and fire extinguishers.
- Crossing traffic lanes to access taxi and bus pickup areas.

In addition to these comments the United States uses the “EXIT” to identify emergency egress. Our surveys and research show that a large portion of the world uses the green field with a walking man with an arrow (Figure 6.66). Where the difference can become an issue is an International Arrivals area. Interviews with CBP personnel discussed the recurring issue with foreign passengers mistaking the emergency exits for the airport exit. They report that this is a daily problem that needs to be considered during the design process.

6.7 Sign Maintenance

Wayfinding inside an airport terminal typically does not suffer from substantial degradation of sign surfaces over time like signs in an exterior application that are exposed to the environment. What is important to maintain is the integrity of an airport's wayfinding system so that it keeps pace with changes in the airport.

One of the myths of wayfinding is that once a new sign system is implemented the work is done. This is a false assumption. Airports are dynamic environments that are constantly changing. In order to perpetuate the integrity of the wayfinding program a systematic maintenance program must be implemented as an integral part of standard airport operations.

A strategic maintenance program is the key to perpetuating a well-planned wayfinding program. Standard procedures should be in place to address the impact of changes to airport operations,



Figure 6.66. A large portion of the world uses the green field with a walking man with an arrow to denote “Emergency Exit.”

including clear update policies and scheduled maintenance reviews (quarterly, semi-annually, and annually). Clearly defined procedures will help address issues such as:

- Addition of a new airline,
- Airline relocation,
- Adding signs,
- Deleting signs,
- Temporary signs, and
- Directories, both electronic and static.

Developing a quality Sign Standards Manual will be one of the best tools in managing consistent planning, design, installation, application, and maintenance of the sign system.

As a minimum, the following represents a suggested sign maintenance procedure:

- Monthly visual inspections: check for burned out bulbs/lights, scratched sign cabinets, sign face damage, graffiti, structural damage, and non-standard signing due to signing updates.
- Quarterly sign cleaning: cleaning of exterior surfaces and support structures. Twice a year the interior of sign boxes/cabinets should be examined for build-up of dirt, dust, and other debris.
- Replacement parts such as extra bulbs, hardware, and mechanical fasteners should be on hand to provide quick fixes until complete repairs can be made if needed.
- Replacement and recycling/disposal procedures: determine how damaged or obsolete signs will be removed and where the unusable items will be discarded.

Sign maintenance manual: a maintenance manual should be prepared for in-house information but can also be distributed to sign vendors to be aware of the airport’s expectations for new signs.

6.8 Accessibility

Accessibility issues in an airport setting extend beyond the terminal, but are consolidated in this section for an easy single point of reference. The information contained in this section is based on the Americans with Disabilities Act Accessibility Guidelines and the Air Carrier Access Act.

6.8.1 Accessible Signing—Wayfinding for the Blind and Visually Impaired

Wayfinding for the blind and visually impaired is a crucial area in the design of airport facilities. This section will review both the accessibility codes that must be followed in developing a wayfinding program in an airport facility but also the technologies and other innovations that are being integrated into airport facilities. Finally this section will provide a road map for designers and managers looking to integrate accessible wayfinding into their facility plans.

This section is meant to be utilized by designers and managers in three stages including:

- Managing Codes and Code Compliance
- Developing specific strategies for sign legibility for both the blind and visually impaired based on accessibility codes and best practices.
- Utilizing methodologies and new technologies to meet the needs of disabled travelers throughout the entire airport experience

6.8.1.1 Accessibility Analysis for Pedestrian Airport Wayfinding

Figure 6.67 has been developed to help analyze the wayfinding experience from an accessibility perspective of getting to the gate as well as getting from the gate to ground transportation. The first column lists each step in the wayfinding experience. Column two lists the ADA requirement associated with each step of the experience. Column three addresses the legibility requirement. Column four lists any additional considerations associated with each step in the wayfinding experience.

6.8.1.2 Managing Codes and Code Compliance

A number of different codes and guidelines determine how accessible wayfinding programs are to be developed. The two most prevalent are:

The ADA and International Building Code: Passed in 1991 and was updated, and the new regulations were published in the *Federal Register* on September 15, 2010. These final rules took effect on March 15, 2011. The Americans with Disabilities Act provides a range of design issues that states must enforce in their building code. States also have the right to create their own accessible building codes, and most states have adopted more advanced accessibility codes developed by the American National Standards Institute (ANSI). Most international airports around the world utilize the accessibility section of the International Building Code (IBC) which parallels the ANSI.

Specific legislation has also been developed to serve the needs of blind and visually impaired travelers including the Air Travelers Access Act. This legislation is not as prescriptive as building codes, allowing for a range of new innovations and methodologies to be applied.

The first priority of designers and managers is to **manage compliance of accessibility codes**. This is made more complex by the way accessibility guidelines are legislated. States have the right to develop their own guidelines based on minimum standards from the Justice Department. For example, in California, signs follow a code that requires sign heights to be 60" from the floor to the center of the sign, which deviates from the new ANSI and International Building Code. The US Access Board and SEGD both offer up to date information on state by state building codes and current international guidelines. The guidelines are based on the 2008 ANSI, IBC and the ADA code that was approved in 2010. Twenty-six states representing $\frac{2}{3}$ of the U.S. population are utilizing codes following these guidelines. It is important though that airports review the codes relevant to their state or locality.

Wayfinding Experience	ADA	Legibility	Experience
To the Gate			
Pre-Trip			<ul style="list-style-type: none"> Accessible web site
Parking Garage	<ul style="list-style-type: none"> Minimum letter and sign heights apply. Raised letters and Braille on elevator floor buttons and identification. Raised letters and Braille on stair egress. 	<ul style="list-style-type: none"> Minimum letter heights of 2" on overhead signs on low ceilings. 	
Transportation	<ul style="list-style-type: none"> Detectable warnings at all platforms Minimum letter and sign heights apply on all wayfinding and identification signs. 	<ul style="list-style-type: none"> Minimum letter heights of 2" on overhead signs on low ceilings. 	<ul style="list-style-type: none"> Rules for taxis for seeing eye dog space and assistance. Audible GPS maps. Audible warnings in transit system. Detectable warning strips and rails. Assistance from transit workers. Caption display for all audible information.
Curbside	<ul style="list-style-type: none"> Minimum letter and sign heights apply on all wayfinding and identification signs. 	<ul style="list-style-type: none"> 6" minimum letter heights for overhead signs to be used by vehicles. 	<ul style="list-style-type: none"> Detectable warning strips from the curb to the inside of the airport. Audio GPS maps for airport.
Ticketing		<ul style="list-style-type: none"> Digital signs should have a letter height of 5/8" for eye level signs and 2" minimum for overhead signs. 	<ul style="list-style-type: none"> Airline staff trained to take the person from ticketing to the gate. Caption display for all audible information.
Security	<ul style="list-style-type: none"> Minimum letter and sign heights apply on all wayfinding, identification and informational signs. Based on a 6' distance. (Minimum 5/8" letter height). 		<ul style="list-style-type: none"> Short cut security procedure. Caption display for all audible information.

Figure 6.67. This matrix helps analyze the wayfinding experience from an accessibility perspective of getting to the gate as well as getting from the gate to ground transportation.

Restrooms and Support	<ul style="list-style-type: none"> Braille and tactile letter signs for all permanent identification signs in the airport including restrooms, gates, offices, and telephones. Two signs highly recommended. Tactile at 48"-60" and visual at 7'+. Symbols in a 6" field highly recommended but not required. 	<ul style="list-style-type: none"> Symbols should be at least 12" for overhead identification signs. Wayfinding signs should be a minimum 3" letter heights unless symbols are used. Minimum letter heights and color contrast for all dynamic signage based on a 6' viewing distance (5/8"). 	<ul style="list-style-type: none"> Clearly located and instructed visitor information services for the blind.
Gate	<ul style="list-style-type: none"> Braille and tactile letter signs for all permanent identification signs in the airport including restrooms, gates, offices, and telephones. Two signs highly recommended. Tactile at 48"-60" and visual at 7'+. 	<ul style="list-style-type: none"> Minimum letter heights and color contrast for all dynamic and fixed signage based on a 3" letter height. 	<ul style="list-style-type: none"> Airline staff trained at the gate counter for special accommodations in boarding.
From the Gate			
Baggage Claim	<ul style="list-style-type: none"> Two signs highly recommended, tactile at 48"-60" and visual at 7'+. Retail signs are not included. 	<ul style="list-style-type: none"> Minimum letter heights and color contrast for all dynamic signage based on 3" in height. 	
Ground Transportation		<ul style="list-style-type: none"> Minimum letter heights and color contrast for all dynamic and fixed signage based on a 2" letter height for low ceilings and 3" + for higher ceiling heights. 	

Figure 6.67. (Continued).

6.8.1.3 Types of Visual Impairments

To develop effective wayfinding standards, it is first important to understand the different needs of the blind and visually impaired. The sign standards for these two groups often conflict with each other in the wayfinding environment. These issues include:

The needs of the blind. The blind navigate their environment utilizing their sense of touch either through their hands, feet, extension device like a cane, dog, or navigation device. The blind need wayfinding elements to be in close range to their body, tactile, and in consistent locations. This effort to provide consistency of location and information is both the common theme in accessibility codes and design innovations for the blind like rails and tactile floor surfaces.

The needs of the visually impaired. The visually impaired make up a very large percentage of the population and cover a variety of impairments from color blindness to eye degradation from aging. The visually impaired utilize their eyes to navigate their environment, but need the assistance of larger and clearer visual elements that contrast with the surrounding environment. The needs of the blind and the visually impaired often conflict in building codes and often require different systems in airport environments.

The needs of the mobility impaired. Mobility impairment covers a range of impairments including difficulty of movement and paralysis. Access for the mobility impaired includes having dynamic and interactive wayfinding elements in close visual proximity which often conflicts with the need for more visible signs.

6.8.1.4 Strategies for the Blind

The ADA and by extension the ANSI and IBC has extensive and specific guidance for the blind. Keep in mind that this is just guidance based on the state, national, and international codes being utilized in most places. It is important to reference the code based on the specific airport jurisdiction. These are the key issues that must be considered.

What signs are covered. For the blind, only permanent identification signs must utilize Braille and tactile copy. In an airport environment this includes all restroom and terminal signs on concourses as well as permanent office and meeting room space. Specific airline information and retail spaces are not considered permanent space. Directional signs are not included.

Font selection and letter height. All tactile letters must be a minimum of $\frac{5}{8}$ " high and a maximum of 2" high. $\frac{1}{2}$ " letter heights can be used if separate larger visual type is also included.

Letter type. All raised letters must be sans serif and must have a maximum stroke width of $\frac{1}{8}$ of the height of the letter using the height of the letter I for reference.

Font and Braille location. All tactile letters and Braille must be a minimum of $\frac{3}{8}$ " away from any raised surface. See Figure 6.68 for approved fonts for the ADA.

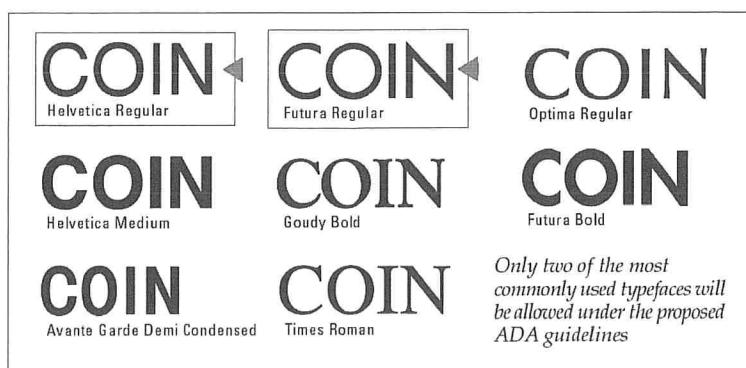


Figure 6.68. Approved fonts for the ADA.

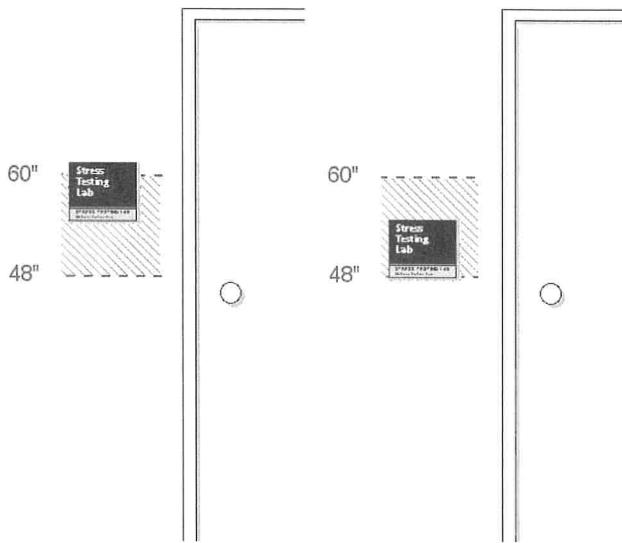


Figure 6.69. Sign height diagram.

Font and Braille height: Tactile letters must be no higher than 60" from the floor to the top of the raised letters. Braille must be below and no lower than 48" from the bottom of the Braille to the floor. Refer to Figure 6.69 for more details.

Sign location. All signs must be located a specific distance away from single and double doors. Refer to Figure 6.70 for specific locations.

Overhead signs and signs perpendicular to wall surfaces. All overhead signs and signs perpendicular to wall surfaces must be at least 70" off the floor surface and preferably a minimum of 84".

6.8.1.5 Strategies for the Visually Impaired

Developing wayfinding programs for the visually impaired is a combination of specific code requirements as well as best practices for legibility in the environment. The ADA and accessibility codes cover the following issues.

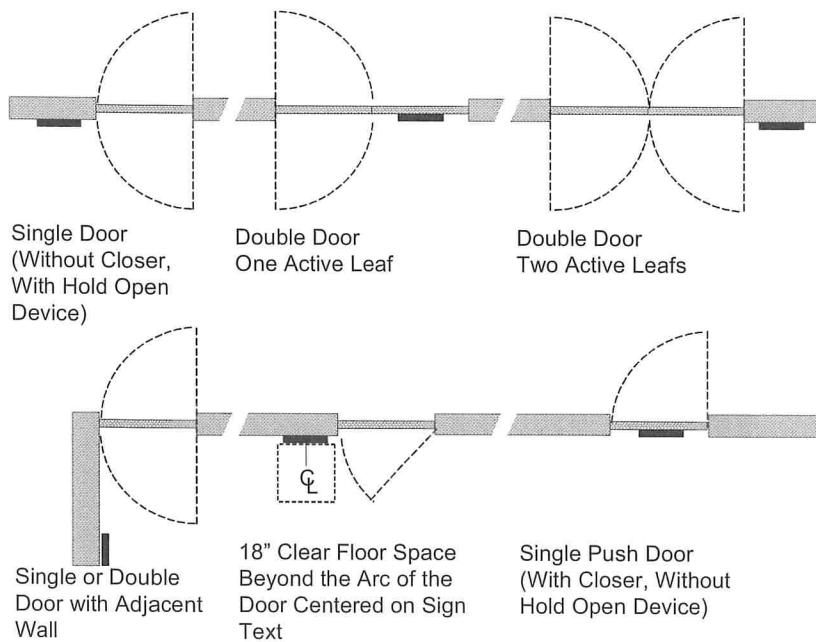


Figure 6.70. Sign location diagram.

Specific signs types covered under the ADA, ANSI, and IBC. All directional and identification signs are covered including overhead signs and wall mounted directory signs. Dynamic signs and schedules must also be covered under these guidelines. Maps are not covered in accessibility codes but may be required in local fire codes.

Color contrast. All letters and arrows must contrast with the background. A 70% light reflectance value (LRV) is recommended but not required. All signs must also have a matte non-glossy finish.

Symbols. All identification symbols must be in a minimum 6-inch field even though they do not need to be a minimum of 6-inches in height. This is a requirement on identification signs and a recommendation on wayfinding signs. There is still an open discussion in different states about allowing smaller letter heights if large symbols are used in wayfinding signs. Chicago's O'Hare airport by Carol Naughton and Associates, Figure 6.71, has led these trends with large symbols/small text on some of their major wayfinding signs.

Text height. Text can be serif and any stroke width, but must be a minimum of $\frac{1}{2}$ inches in height. Text height also increases based on the height off the floor and the distance viewing. This is important distance information particularly for dynamic scheduling signs (Figures 6.72 and 6.73). These signs must be no more than 6 feet away from the viewer to keep the $\frac{1}{2}$ inches in letter height requirement. All overhead signs generally must have text at least 2 inches in height and often far larger text heights are required.

6.8.1.6 Best Practices for the Visually Impaired

In addition to building codes, a number of best practices have been utilized in airport facilities for visually impaired that have been advised by a number of designers.

These best practices include the use of highly-legible san serif fonts. Even though building codes do not require these fonts on wayfinding signs most airports utilize highly legible san serif fonts. The most prevalent of these fonts include Helvetica, Clearview, Futura, and Frutiger. These fonts were designed to meet the needs of an aging population by mitigating halation or the diminishment of visual clarity over time. These fonts have thin lines that have been successfully tested to be visible over great distances.

Clutter reduction. A key to legibility in an airport environment is the reduction of clutter in key areas. This is especially important at airport facilities with low ceilings. Design firms advise that



Figure 6.71. Example of large symbols used with smaller text.

ADAAG 703.5.5 Visual Character Height

Height to Finish Floor or Ground From Baseline of Character	Horizontal Viewing Distance	Minimum Character Height
40 inches (1015 mm) to less than or equal to 70 inches (1780 mm)	less than 72 inches (1830 mm)	5/8 inch (16 mm)
	72 inches (1830 mm) and greater	5/8 inch (16 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 72 inches (1830 mm)
Greater than 70 inches (1780 mm) to less than or equal to 120 inches (3050 mm)	less than 180 inches (4570 mm)	2 inches (51 mm)
	180 inches (4570 mm) and greater	2 inches (51 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 180 inches (4570 mm)
Greater than 120 inches (3050 mm)	less than 21 feet (6400 mm)	3 inches (75 mm)
	21 feet (6400 mm) and greater	3 inches (75 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 21 feet (6400 mm)

Figure 6.72. ADAAG legibility chart.



Figure 6.73. In the Minneapolis International Airport Sign System by Apple Design, multiple changes in ceiling height require different font heights to be used.



Figure 6.74. T.F. Green Airport.

extensive visual models and prototypes should be developed to ensure a minimum of clutter in the facility, as well as rigorous guidelines to keep visual clutter to a minimum. Clear guidelines are key to preventing the proliferation of visual clutter in airport environments, and airport sign managers should require that every new interior sign be reviewed based on guidelines governing clutter. Medium size airports like T.F. Green Airport in Providence (Figure 6.74) are notable for their efforts to manage clutter by creating layered viewing corridors for retail, wayfinding, gate and support information.

The use of landmarks. Visual cues and landmarks are important elements for directing airport users to specific locations and also cutting through the visual clutter. Toronto Pearson Airport (Figure 6.75) uses landmarks extensively to break through the visual clutter of the complex spaces in the facility.

Multiple languages. When multiple languages are used on a sign, it is important that the same standards of legibility are used for all languages. It is also important that multiple languages are differentiated on a sign like at Ottawa McDaniel Airport designed by Gottshalk and Ash (Figure 6.76).

Typography strategy. Sign codes are specific about type height for various viewing distances for wayfinding signs but are unclear about how to measure viewing distances themselves. A basic strategy that has evolved is about basing legibility distance on two levels of wayfinding decision.



Figure 6.75. Toronto Pearson International Airport.



Figure 6.76. Ottawa McDaniel Airport.

Key destination information. Top destinations including Gates, Transportation and Baggage Claim often need priority at key decision points and in airports with long concourses often require font heights of 6 feet or more.

Key decision points. In an airport environment key decision points should be read from at least 120 feet away. Under the accessibility codes this would require font heights to be a minimum of 4 feet.

Assurance signs. These signs occur along pathways and are meant to assure the traveler that they are moving in the right direction. These signs need to be read from 90 feet or less giving them a minimum font height of 3 feet.

At Newark Liberty International (Figure 6.77) a strategy for font sizes was based on destination hierarchy and key decision points, allowing for more legible signs throughout the airport.

6.8.1.7 The Mobility Impaired

Codes oriented for wayfinding for the mobility impaired focus on the same issues that address the blind including the height of signs off the ground and the size of sign information. Most issues related to the mobility impaired are addressed in the Air Carrier Access Act which governs the support services of the airport facility as much as specific wayfinding legibility issues.



Figure 6.77. Newark Liberty International.

6.8.1.8 ADA Symbols

Symbols are among the most crucial aspects of developing airport wayfinding program. The ADA, ANSI and IBC cover the size and application of symbols as well as the use of specific accessibility symbols. Roger Whitehouse, working for the SEGD (Figure 6.78) developed this group of accessibility symbols that are mandated for use.

Among the most important areas of guidance is the use of the international symbol of accessibility which is required to identify all accessible locations in a facility including restrooms and areas of refuge. Because the signs codes allow more than one symbol inside a 6-inch field, most identification signs in airports pair a smaller accessibility symbol with a larger identification symbol (Figure 6.79).

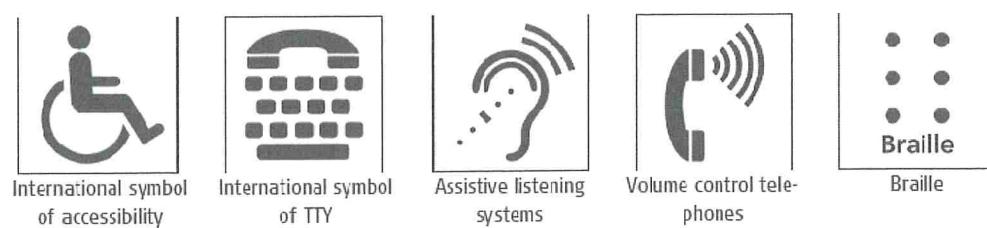
6.8.1.9 Dual Signs

In an effort to resolve the sign standards between the blind and the visually impaired, the ADA, ANSI, and IBC allow for the use of dual signs or separate sign information for the blind and the visually impaired. The visual information can be any size and use a variety of fonts while tactile signs can be smaller with low color contrast. This is particularly important on airport signs because of the need for identification elements to be more legible from larger distances. Airports generally use two approaches when developing dual signs.

Perpendicular and wall mounted signs. An overhead perpendicular sign can be coupled with a wall mounted tactile sign.

Combined wall mounted sign. A large wall mounted sign containing both visual and tactile information.

Specific international accessibility symbols are mandated for use by ADAAG (703.7.2.1-703.7.2.4) and include:



(These symbols were designed by Roger Whitehouse and available through SEGD.)

Figure 6.78. Accessibility symbols.



Figure 6.79. Symbol sign.

Dual signs are needed particularly at restroom facilities at all airports regardless of size, but also for other support services, like gate information and telephone identification (Figure 6.80).

6.8.1.10 Deaf Users

These users require special assistance to find facilities that service the deaf. Wayfinding for assistive listening devices and volume control telephones are usually handled by universal ADA symbols developed by Roger Whitehouse for SEGD.

6.8.1.11 The ADA and Dynamic Messages

Technically the ADA does not cover temporary or variable messages yet, but the trend is moving in the direction of utilizing the same regulations for visual dynamic media that applied to signs with permanent content. Key issues for dynamic media include the following:

- Accessibility: Having passenger arrival and departure information within close visual proximity to travelers, either through scrolling signs, or larger font sizes.
- Contrast: All dynamic messages are recommended to have a contrast of at least 70%.

At Hong Kong International Airport (Figure 6.81) redundant combinations of dynamic message signs are placed low to the ground for the mobility impaired and overhead with larger font sizes for the visually impaired.

6.8.1.12 New Approaches for Accessible Environments

Research for wayfinding for the visually impaired in transit and other facilities has been extensive. For the visually impaired and blind, the Lighthouse for the Blind in New York has commissioned dozens of studies on best practices for wayfinding, identification, and map signs (Figure 6.82 provides one example of a map with raised pathways). The most well known was a study developed based on a wayfinding system for the blind developed by Roger Whitehouse for the Lighthouse itself⁴⁷. This study profiled a number of approaches to blind navigation including audible signs, maps, and trails.



Figure 6.80. Dual signs at Minneapolis International Airport.

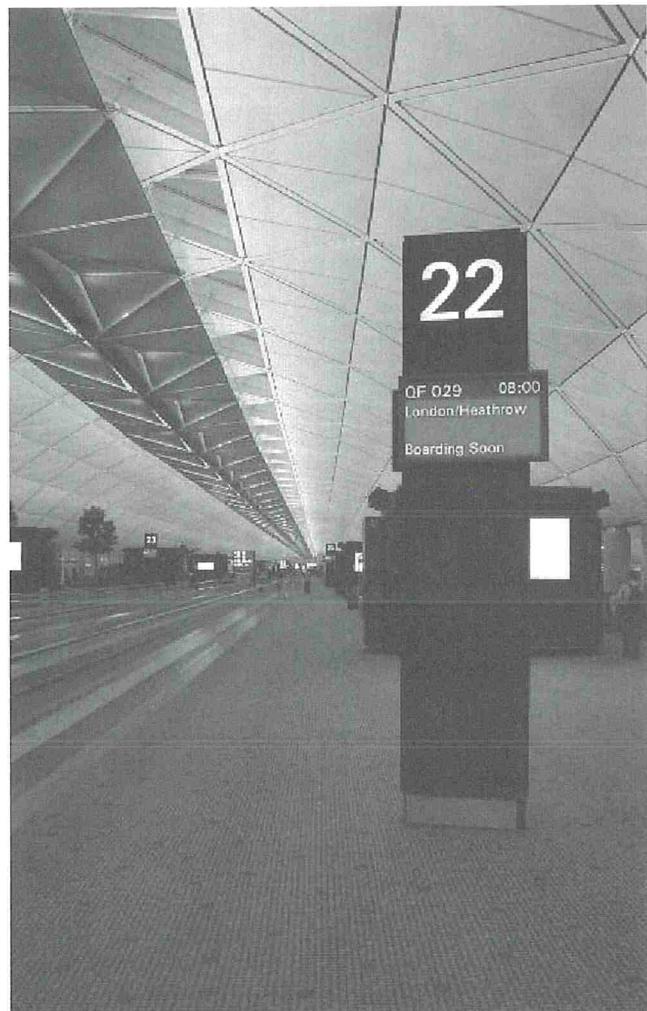


Figure 6.81. Hong Kong International Airport.

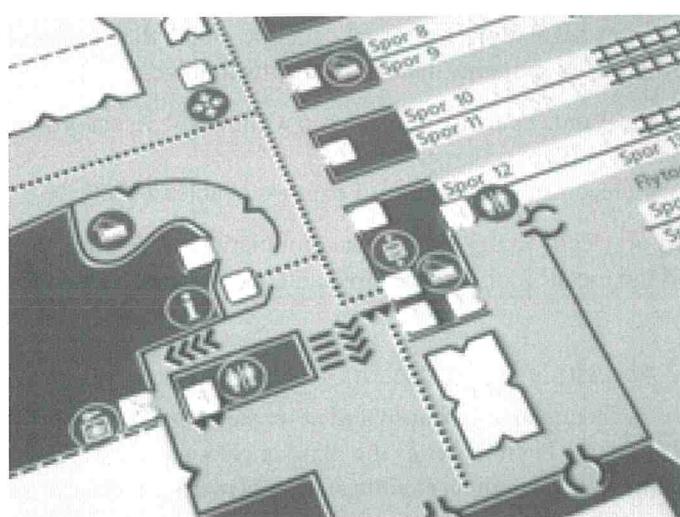
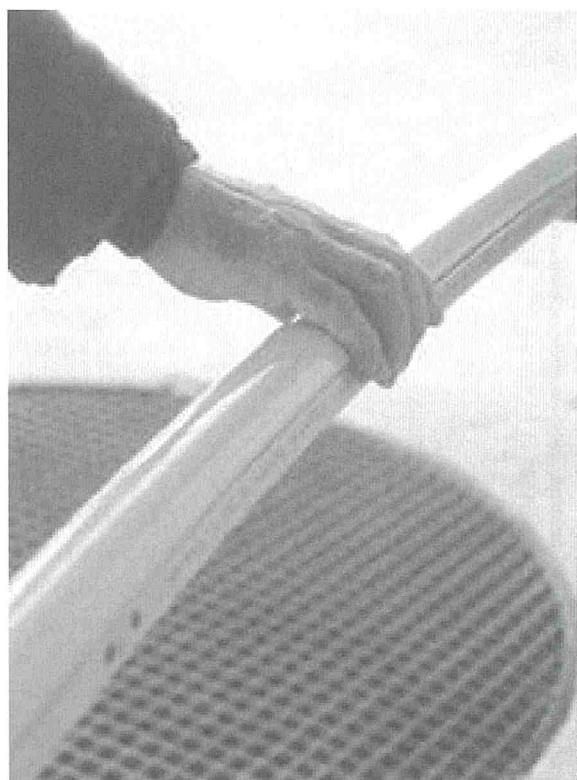


Figure 6.82. Tactile map with raised pathways, directions, and destinations developed by Eyecatch Signs.



Source: Coco Raynes Associates, Inc.

Figure 6.83. Charles De Gaulle Airport.

Currently auditory technology is being frequently employed in transportation facilities for the disabled including train and bus stations. In addition to the Lighthouse for the Blind, testing has been utilized for auditory devices in facilities by the U.S. Access Board and National Institute on Disability and Rehabilitation Research. Auditory technologies include push buttons, infrared transmitters, and cell phone based technologies. The newest system, tested at the Sloan Kettering Institute for the Visually Impaired by James Coughlan, Roberto Manduchi, and Huiying Shen uses bar codes that can be read by cell phones. The most commonly used system in airports is the ClickAndGo Wayfinding Maps and Human Network Labs software. This software is available on cell phones and PDA's and can be used by the blind through Braille converters. Airports can send map routes through specialized websites to be used with this system. Cell phones are also being used to deliver greater in-flight information to the blind through software created by companies like human network labs.

Finally research has been developed for complete systems that use maps, rails, floor markings, and auditory information in a transportation environment like the integrated system developed by Coco Raynes at Charles De Gaulle Airport in Paris (see Figure 6.83). These trails connect terminal facilities inside of airports. Institutes that study architectural and integrated solutions include Universal Design at North Carolina State University (<http://www.design.ncsu.edu/cud>) and the Center for Inclusive Design and Environmental Access (IDEA). These institutes study the interplay of architectural and accessible environments.

6.8.1.13 Air Carrier Access Act—Overview and Recommendations

Airports specifically have been given recent guidance on disabilities issues with the recently enacted Air Carrier Access Act. This act specifically puts the responsibility on the airport and the airline to provide assistance and access for the disabled from curbside to airplane. The best way


**CASE
STUDY**
Wayfinding for the Visually Impaired Traveler

San Jose International Airport is a fast growing national and international airport in the San Francisco Bay Corridor. Located in a state with among the most stringent accessibility enforcement criteria, the airport has developed a number of practices to ensure compliance with all state and federal codes as well as incorporating innovations into new additions and renovations to the airport environment. San Jose has been successful in the development and management of accessibility guidelines, by taking internal responsibility for many of the decisions governing accessible environments. The approach that the airport has developed includes:

Development of a Compliance Strategy

California's Title 24 differs markedly for national accessibility codes and the airport must respond to these differences through clear guidelines when working with the variety of outside design firms and contractors involved in projects. One important approach is to include Title 24 standards in the RFP process as well as in-house sign development procedures. In particular the airport closely monitors these specific areas as part of their compliance strategy:

Sign Heights: Title 24 specifies that all signs must be positioned 60" from the center of the sign to the floor. This matches the current federal ADA guideline, but not current ANSI guidelines as well as state codes from a number of other states. The airport closely watches that this standard is met when working with multiple designers and fabricators developing sign programs in the facility.

Specific Symbols and Braille: California uses specific symbols for restroom signs and Braille that are unique to the state. The airport ensures that it has guidelines and procedures in place to ensure the use of these elements when new signs are being added and existing signs are changed.

Enforcement: California has a specific permitting approach for developing new sign systems in facilities. The airport has developed specific procedures in concert with designers and fabricators to ensure that the permitting process is being followed.

Legibility Strategy

Unique to most airports, San Jose develops legibility guidelines in-house to allow for more control over the management of ongoing sign programs. These legibility guidelines include standard governing destination hierarchy and font heights throughout the airport facility as well as guidelines governing the placement of signs to reduce clutter and standards for color contrast and lighting. By developing these rules in-house the requirements can change with the growth of the airport and the addition of new wayfinding, identification and retail signs. The most important elements of the airport's legibility strategy include:

Font Height Strategy: Accessibility codes are ambiguous about determining the specific font height to use at the airport. San Jose has created standards that govern specific font heights based on location in the airport. Key decision points require signs with larger fonts of 5 or more inches in height while signs that provide assurance along corridors have smaller font heights of 3 to 5 inches.

Clutter Management: During the design development process the airport closely monitors the density of signs along key viewing corridors utilizing modeling software from the designer. Whenever new signs are put in place as part of ongoing sign management the airport includes criteria for placement that minimizes size clutter.

Managing the Wayfinding Experience

To meet the needs of the newly enacted Air Carriers Access Act, San Jose has developed an experiential analysis approach based on interviews with the blind and visually disabled as well as supporting views from consultants and advocates for the disabled. The prepared report charts the wayfinding experience for the disabled throughout the airport, providing recommendations at specific decision points. In developing their experiential analysis the airport began with a profile of the disabled traveler. This specific profile included the following information:

- There are no expectations when traveling, i.e., no system specifically for blind or visually impaired to help them navigate through the airport.
- Process for handling reservations:
 - Informed the airline that he was traveling with a guide dog.
 - Airline has to block a seat to make room for the dog.
 - Prefers to take direct flights—do not want to change planes
- The travel experience
 - Uses the Outreach service (on-call service through the local transportation agency) to get to his airline curb, then had family there to help him through the rest of the way.
 - In two other trips, either a friend or a driver took him to the departure curb and led him to the door and the airline desk.
- Preparations for traveling with a guide dog.
 - He does not water or feed his dog before the trip
 - Dog cannot help in a crowded environment
- Other preparations for travel
 - Typically does not go to the website.
 - Usually calls the airline for information. So if there are physical changes, communicate that to the airlines.

After developing this profile the traveler was interviewed about issues specific to their wayfinding experience. Results include:

- The use of the handicapped drop-off curb
 - Would not use it. Reserve it for the individual in a wheelchair.
 - Likely rare to be blind and in a wheelchair and expect independence.
 - Would not want to be dropped off in a central location. Just wants the direct door into the ticketing hall where his airline is.
- The use of tactile elements
 - There are too many points of entry for tactile strips.
 - Tactile strips could have a benefit if taxi driver stops right in front of the strip, and it is known as a clear path into the terminal.
 - Tactile strip, over time, may get worn down due to constant passing of baggage on rollers.

- The traveler expectation from the curb
 - Walk straight ahead from curb, through door to the counter
 - Ask for assistance. No matter how independent the blind traveler is always conditioned to ask for assistance as soon as possible.
- Navigation through airport and security line
 - Understands that airports are a fluid space. Has to ask for assistance.
 - It is understood that the airline will walk the traveler all the way to the gate from the ticket counter.
 - If using a security line, it is possible to follow the stanchions/crowd barrier tape.
- Arriving at other airport and return trip
 - Airline will escort through baggage claim. Per the Air Carrier Access Act, the airline has to assist the traveler all the way through to the point of departing the airport such as taking him to a taxi or shuttle.
 - Upon return to SJC, he will ask the airline to take him to the Outreach pickup curb
 - He calls ahead and makes pickup reservation.
 - There is a benefit of having the Outreach pickup curb include a sign with tactile (raised) text and Braille to confirm this destination.

After concluding the profile and interview process, additional consultants were consulted about best practices for the blind and how to best comply with the provisions of the Air Carrier Access Act. Once these additional elements were in place the airport developed a set of specific recommendations to comply with the provisions of the act and meet the specific needs of the profiled travelers.

for airports to respond to the Act is to map the experience of the disabled traveler from external transportation to the gate. These include the following areas:

- **Parking**—While the Air Carriers Act makes no provisions for assistance from parking, many airports require parking in short-term areas instead of curbside drop-off. In these situations it is important to provide clear easily marked safe areas where the traveler can wait for assistance.
- **Transit**—Taxi drivers and transit attendants can be trained to assist the blind in finding their way into airline terminals. In addition transit/airport junction points can become the most forward information centers with trained staff available. This approach has been used successfully in large international airports with transit hubs like Chicago O'Hare airport and Boston Logan International Airport.
- **Curbside Assistance**—Karl Vidt, former member of the Airports ADA Advisory Committee has commented that assistance must begin at curbside. Even the best wayfinding systems for the blind at the arrivals and departures areas of the airport can be stymied by the large lines and crowds at a number of the airlines. This requires baggage handlers and other curbside personnel to take responsibility when seeing a disabled person trying to enter the terminal. In addition some airports hire security guards and greeters that can also offer assistance.

In addition there are tactile technologies that can assist the blind from curbside to check-in. One of the leading technologies utilized to direct the blind from curbside to check-ins are detectable warning systems including floor dots, domes, pavers and trails. These approaches are common in Europe and are starting to be seen near rail transportation and in airports (see Figure 6.84).

From check-in to the gate: The Open Doors Organization (<http://www.opendoorsonfp.org>) has profiled a number of different training options the organization offers to assist the blind in airport facilities. Best Practices for these human centered approaches are also available through



Figure 6.84. *Tactile technologies, such as floor dots, can assist the blind from curbside to check-in.*

Canadian Transportation Agency's new Code of Practice and Guide for Passenger Terminal Accessibility (www.cta.gc.ca). These training areas chart the wayfinding experience from roadway to terminal and include the following:

- **Ticketing Assistance**—Ticketing is the most crucial junction point for the blind. This is the point where the airline can offer assistance all the way to the gate. Training of ticket takers is the most important aspect of the Air Carrier Access Act, since it is the first entry point where the airline takes responsibility for the traveler.
- **Security**—Most security lines are already set up to handle the blind through multiple layers of security assistance and clear stanchion based lines.
- **Attendants**—Because of the Air Carrier Access Act airlines must have a person on call that can take a visitor from curbside, through security, and all the way to the gate. This requires pre-trip preparation on the part of the disabled visitor, but also a plan devised by the airport to connect the disabled traveler with the attendant including a call-in number and designated meeting spot.

6.8.1.14 Airport Challenges

Airports are among the most difficult wayfinding environments for the blind and visually impaired with multiple layers of complexity. Airport sign managers and design firms advise that airports utilize the following approaches to ensure that the environment can remain at a high standard of accessibility:

- Develop an accessibility plan and audit: During the wayfinding design and development process it is important to have a separate audit that just focuses on accessibility issues.
- Have clear ongoing accessibility guidelines: After a project is complete these guidelines will serve as both instruction and training for airport employees and guidance for system maintenance and replacement.
- Develop an in-house expertise: Large airports should have one person responsible for managing accessibility issues while small and medium size airports should have specific departmental responsibilities for accessibility.

- Develop a resources list: This list of designers, code officials, organizations, and internal stakeholders can provide guidance on key issues and conflicts.

6.8.1.15 Accessibility Audit

On an airport wayfinding project, it is important to develop an audit of elements that must be followed to make the facility accessible. The audit consists of two parts: Strategy and Documentation:

Strategy

All accessibility strategies should consist of the following parts:

Managing Compliance

- International, national and state codes.
- Utilize the International Building Code for projects outside the United States. This will correspond with the current ADA.
- List the top ADA national standards being followed at the state level regarding font, placement, and color.
- List ADA issues specific to the state that may diverge from national standards.
- List the provisions in the Air Carriers Access Act.

Managing Legibility

- Develop a legibility plan consisting of the following elements:
- Font height based on distance in the facility.
- Color contrast and lighting contrast requirements.
- An approach to sign clutter.
- Symbol height based on distance and number of symbols being used.
- An approach for multiple languages.

Managing the Experience

- Develop a narrative of the wayfinding experience.
- Write an accessibility narrative starting at the curb, and progressing to the gate, describing the specific issues and recommendations for each area in the wayfinding process.
- Develop a series of recommendations based on the needs of the blind, visually impaired and mobility impaired.

Specifying Methodologies and Technologies

- Materials specifications.
- Name the specific modular system (if one is used) and accessibility issues associated with that system.
- Specify materials, the material approach, vendors/manufacturers (if necessary), and paint or additional materials being applied.
- Include specific accessibility technologies and methodologies.
- Directories and maps.
- Human assistance.
- Talking signs.
- Tactile floor surface.

Documentation

All accessibility documents for tactile signs for the blind should consist of the following parts:

- Sign placement.
- Distance of the sign from doors and entrances.

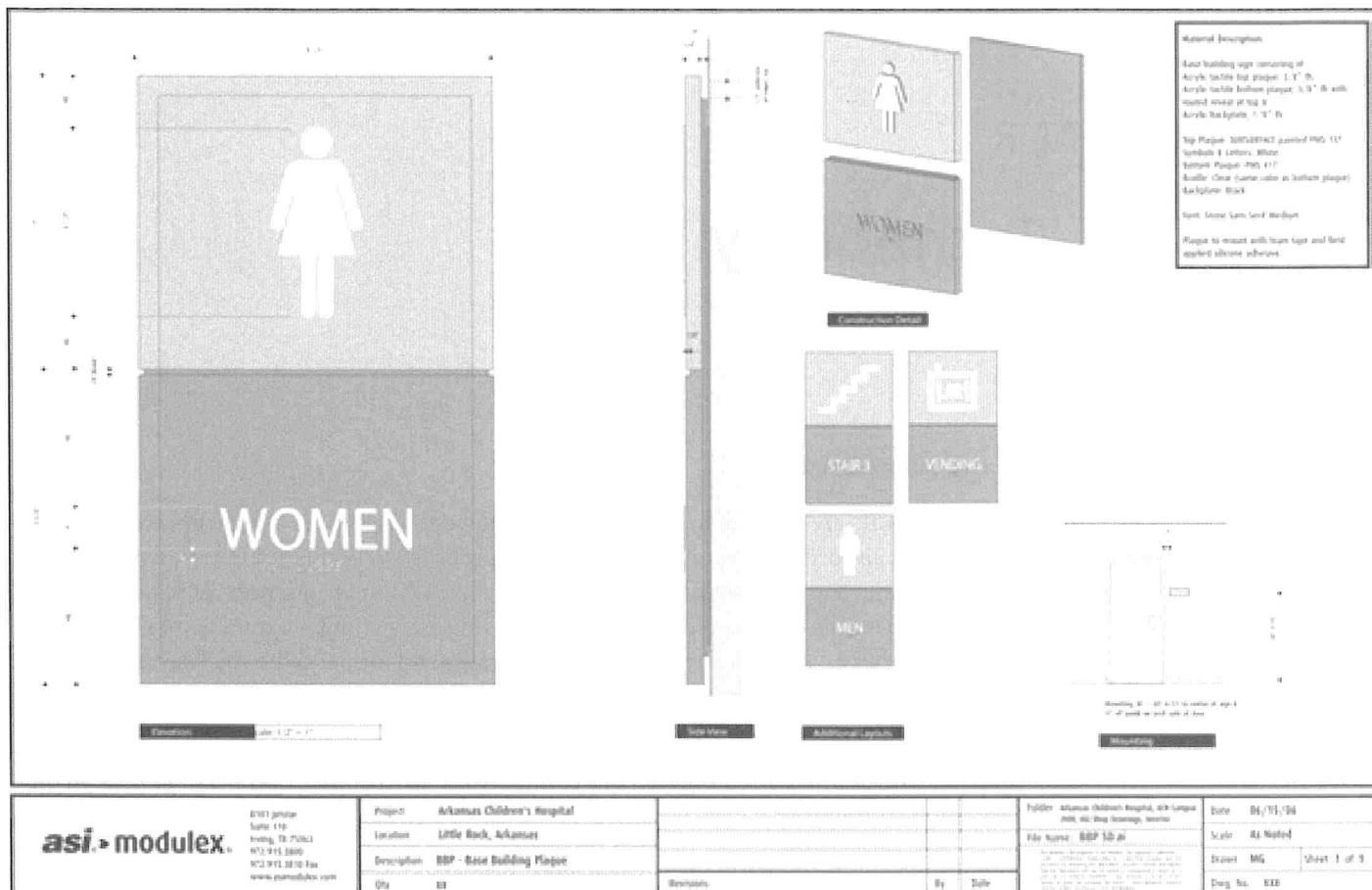


Figure 6.85. A sample of required documentations for accessible tactile signs developed by ASI.

- Height of perpendicular wall signs and overhead signs from the floor.
- Sign dimensions.
- Separation of fonts from Braille.
- Separation of font and Braille from the edge of the sign.
- Distance of the top and bottom of the font from floor.
- Fonts.
- Style.
- Height.
- Kerning.
- Specify Braille and distance of the Braille from the floor.
- Sign substrate and base material.
- Ensure all screws are flush if close to raised type.
- Show edging or rounding of materials.
- Show material and substrate thickness.
- Paint specification.
- Specify foreground and background color of materials.
- Specify matte finishing.

Figure 6.85 is a sample of required documentations for accessible tactile signs.



CHAPTER 7

Technology

7.1 Overview

Today, airports are a dynamic operation constantly evolving. Space and facilities are at a premium in most airports. To maximize the use of an airport's assets, it is not unusual for an airport to require airlines and other leaseholders to share facilities through common use leasehold agreements. This operation effectively changes the wayfinding and signing program within the terminal and concourse areas, at curbside, in the parking garages and lots, and the roadway. Airports use dynamic signage to display the changes. Good planning is necessary to accommodate these signage changes rapidly.

The following should be considered in a common-use environment as related to the dynamic information component.

- Communications infrastructure, which allow message changes without having to go to each sign.
- How static messages match dynamic messages.
- Ensuring that dynamic signage follow the wayfinding standards adopted by the Airport (e.g., fonts, colors, pictograms, terminology, and others).
- Integration with existing dynamic signage elements and other systems (e.g. FIDS, BIDS, Parking, CUTE/MUSE).
- Location of key decision points.
- Spacing of displays, information content, visibility of the message, legibility, and mounting.
- Consistency in terminology.

Dynamic signs will be controlled and messages will be changed from a remote location. The method for getting the message data to the actual sign can be via direct connection with a laptop or any number of other methods via a remote computer communicating through an Ethernet connection over copper cables, fiber optic cable, radio frequency (RF) links, or cellular transmission.

This chapter, although addressing certain dynamic signage, does not address all dynamic signage. Refer to the chapters for Roadway, Parking, Curbside, and the Terminal where dynamic signage applicable to those areas is addressed.

7.1.1 Importance of Sign Manager Knowledge of Systems

Many airport managers, airport operations managers, and sign managers have a relatively good working knowledge of computer hardware, software, and computer networks. However, when implementing a new wayfinding and signing system, in order to maximize the use of existing communication systems infrastructure and to minimize potential costs, it is advisable that a member

of the Airport's Information Technology Department be included in any wayfinding and signing project during planning, design, implementation, acceptance testing, and training.

Many times the airport sign manager is the last to know about a signage project, which means they walk in to find a new system, or hear it is being developed and on the way to design completion. This should not be the case and an airport should have processes, checks, and balances to keep the airport sign manager informed of any project that impacts the signing and wayfinding system. In short, this means they have to jump in and must participate quickly to ensure consistency with the signage program in terms of nomenclature, appearance, the airport's signage standards, and creating a signage database for quantities and deliverables. Airport sign managers should be kept informed about all new projects that may affect existing signage—or contain a new signage element—at the planning phases to ensure signing consistency throughout the airport.

7.1.2 Application

Due to extensive growth within the dynamic signage markets (e.g., retail, financial, health-care, transportation, etc.) networked digital signage solutions are beginning to appear. These are well-suited to handle extensive creation, management, and publishing capabilities. New dynamic signage offers the delivery of such information to diverse digital dynamic signage using existing network infrastructure.

One of the advantages of these types of systems is that the displays merely become network addresses to which the centralized system can push a variety of display information from any number of sources. This allows those displays normally associated with one function to easily take on alternative roles. For example, a Multi-User Flight Information Display System (MUFIDS) could be utilized to perform another function such as emergency messaging, visual paging, advertising, etc.

7.1.3 Wayfinding Planning Process

Wayfinding provides a methodology for people to find their way to and around a destination within a facility. Dynamic sign elements must be included as part of the wayfinding planning process. Understanding the operation of the facility, its schedule, and what they need to find, planners can integrate dynamic sign applications into a wayfinding signage plan that helps guide people through a facility. Requirements for the design and planning process may include:

- An onsite wayfinding analysis and wayfinding-related design review of the existing facility architecture.
- Development of a detailed wayfinding master plan.
- Integration/interface with other system (e.g., MUFIDS, CUSS, audio/visual paging, and parking).
- Determining existing wayfinding and network elements that can be utilized.
- Emergency procedures (e.g., keeping temporary signs in stock for when a power outage occurs).
- Control systems for dimming signs—individually, or as a group.
- Defining communication systems infrastructure needs.
- Developing cost estimates for system implementation, operational, maintenance, staffing, and training.

7.1.4 Integration with Entire Sign System

To the extent possible, it is desirable to utilize existing facilities and infrastructure and to integrate existing facilities with the new equipment. However, many times an existing system is installed utilizing proprietary hardware and software that cannot support the additional new components, or where the head-end and/or remote equipment is unreliable, and/or the hard-

ware or software is at its end of life. Then, consideration should be given to the replacement of these elements.

If this may be the case, then system equipment should be installed that support “open” system architecture standards and protocols to allow the use of several different manufacturers’ systems and devices that do support an “open” system architecture to provide interoperability, compatibility and interchangeability within the wayfinding and signing system.

7.1.5 Integration with Static Signs

Dynamic signs should be used where they are clearly necessary to accommodate a changing state of operations and to provide convenient and timely information to the passengers and patrons. The specific type of dynamic signing device utilized should be one determined most appropriate for the specific application in question.

In general, dynamic message signage manufacturers have a library of MUTCD pictographs for easy insertion into a canned or custom message that can easily be produced in a matter of minutes via drag-and-drop functions in the software provided by the sign manufacturer. In all cases, the dynamic signing equipment for exterior applications should be capable of remote operation and be fully weather proof. Wherever used, dynamic signage fonts, colors, and pictographs should follow the “standards” adopted by the wayfinding and airport Sign Manager.

7.2 Systems and Visual Displays

7.2.1 MUFIDS and BIDS

The Multiple User Flight Information Display System (MUFIDS) provides display of flight information to passengers and patrons by destination city, airline, arrival and departure times, gates, and status of the flight (on-time, delayed, cancelled, or landed). Baggage Information Displays (BIDS), a component of MUFIDS, provides display of baggage claim carousel or baggage belt information. FIDS/BIDS may include displays displaying information to the ramp personnel, on ticket and gate counter back walls, above the jet bridge doors, in various back offices, and above the ticket counter displays (first class/premier check-in, bag check, etc.).

FIDS/BIDS may be integrated with the airlines ticketing and boarding pass system [commonly called CUTE (Common User Terminal Equipment) or MUSE (Multiple User System Equipment)—acronyms developed by the manufacturers], Common Use Self Service (CUSS) system, visual paging, and video advertising.

7.2.2 Concourse-Specific vs. Airport-Wide MUFIDS Displays

Banks of MUFIDS displays that only convey information about flights within a specific concourse can be useful, but such displays are limited with regard to overall customer service. Such displays may be useful for airlines which have many flights concentrated within a specific concourse, but for the vast majority of carriers there is little to be gained from concourse-specific MUFIDS displays.

Display banks showing all flights within the airport (e.g., Airport-wide displays) are the most beneficial for the traveling public since they show all flights from all carriers. These types of display banks provide necessary information for the passengers who are changing planes, switching carriers, trying to determine an alternate route to their final destination, as well as being beneficial to the meeters and greeters. It can also assist passengers and meeters/greeters in determining that they

may be in the wrong concourse for a given flight. Unfortunately, the airport-wide display banks may also be the most costly to implement, due to the number of displays required to show all flights.

It is recommended that such airport-wide display banks be located at strategic points throughout the airport (e.g., Main Terminal and all Concourses). As a minimum, it is recommended that such display banks be located at key strategic terminal locations. Specific locations should be determined during the MUFIDS design phase. The following are examples:

- After ticketing but just prior to entering the security checkpoint.
- Near the entrance to the Automatic People Mover (APM) or Shuttle stations in the main terminal, to allow the passenger to confirm that he is boarding the correct APM or Shuttle to his destination concourse.
- At the exit of APM or Shuttle stations inside the entrance to each concourse. This allows the passenger to determine if they should go left or right into the concourse for their flight.
- Within the baggage claim area, multiple locations showing primarily arriving flights. This would assist passengers in finding the correct baggage carousel or baggage belt for their baggage, as well as assisting the meeters and greeters.
- Areas far removed from the key decision points. Arriving passengers may deplane at the far end of a concourse. Consequently, an argument can be made that MUFIDS displays are warranted at intermittent points throughout the concourses in order that arriving passengers can obtain information relative to their movements. The arriving passenger should not have to reverse their path of travel to go to a new transfer gate because the information is not readily available.

7.2.3 Key Decision Points

The airport Sign Manager must be involved in the following to determine key decision points for the placement of wayfinding signage. These include the following:

- Placement,
- Content and legibility, and
- ADA considerations.

MUFIDS displays are installed at various locations throughout the terminal to provide flight information to the passengers and patrons of the facility. Selection of locations for the displays must coincide with the pathway of the passengers. The selected locations must be readily available for viewing, but not a deterrent to traffic flow.

Locations that would be considered “key” or “strategic” in terms of the passenger being required to make a decision include the following:

- Prior to Ticketing
 - At various pedestrian exits in the parking garages (e.g., inside the APM or Shuttle station), pedestrian exit ways to bus stops for rides to the terminal, exits to walkways to the terminal, particularly, if there are “Y” turns along the pathway to the destination where along the way, a pedestrian must choose which area of the terminal he wants as his final destination (e.g., east end or west end) and in the cell phone waiting parking lots.
- Before ticketing
 - In front of the ticket counters to allow passengers to know the status of the flight. Displays are typically spaced at approximately 250 foot intervals.
- After Ticketing
 - Just prior to entering the security checkpoint.
 - After passing through the security checkpoint.
- Near the entrance to the APM or Shuttle stations in the main terminal—allows the passengers to confirm that they are boarding the correct train to their destination concourse.

- Gates/Concourses
 - At the exit from the APM or Shuttle stations located inside the entrance to each concourse which allows the passenger to determine if he should go left or right into the concourse for his flight.
 - In the concourses spaced at approximately 250 foot intervals. Due to the physical layouts of some concourses, arriving passengers may deplane at the far end of a concourse—a significant distance from those strategic points identified herein. Consequently, an argument can be made that MUFIDS displays are warranted at intermittent points throughout the concourses in order for arriving passengers to obtain information relative to their movements. It makes little sense to locate a display bank at the very end of a concourse due to the limited passenger traffic that would utilize it.
 - Put the MUFIDS displays where people congregate (e.g., food courts, near restrooms, close to directory maps).
 - In the various Airline Club Rooms (usually Airline specific only).
- Baggage Claim
 - Within the baggage claim area—multiple locations of MUFIDS displaying arriving flights and BIDS to assist the passengers in finding the correct baggage carousel or baggage belt for retrieval of their baggage.
- Other Locations
 - In the meeters and greeters hall—provide meeters and greeters with passenger arrivals information.
 - In baggage tunnel areas, operations office, and back office areas—allow support personnel to know specific airline gate and flight status information.

To comply with ADA requirements and/or local ADA guidelines, the MUFIDS would typically display Visual Paging messages on designated monitors, as well as providing MUFIDS data and other selected data in an ADA-compliant format. If Visual Paging is already implemented through the Audio/Visual Paging system, then the MUFIDS should be interfaced to or integrated with that system. See Section 7.28.

7.2.4 Content and Display Goals

Content is the message to be displayed and applicable to any given location. The information must be clear, concise, and legible. Things for content consideration, over and above the standards for fonts, font size, and colors include the following:

- Available space on the display,
- Potential conflicts with tenants,
- Multi-national languages,
- Optimization of visibility,
- Distance from the viewer,
- Avoidance of congestion, and
- Maintenance access.

7.2.5 Display Mounting Options

There are a number of factors involved in whether displays will be mounted vertically or horizontally. These include the type and arrangement of data to be displayed (e.g., airport-wide versus concourse-specific), arrival/departure times, readability distances, font size, and available display width (both vertically and horizontally).

The displays come in a variety of sizes and can be mounted either vertically or horizontally. Upon determining what information will be displayed, the mounting orientation becomes self-fulfilling.

That is, in a vertical orientation, if the data fields (columns) can be fit within the vertical limits of the display, more lines (rows) of information can be fitted on the display. Conversely, if the data fields (columns) cannot fit within the vertical limits of the display, then the display must be mounted in a horizontal orientation. This occurrence requires more displays, since fewer rows can be displayed.

Ultimately, MUFIDS installations should be designed to complement the terminal architecture. Good or bad, this leads to an infinite number of interpretations and potential solutions for mounting these displays. To the extent practical, all MUFIDS display installations should be designed to allow for changes in display sizes and technology evolutions. Universal simple post and rail system display mounts should be considered because, as displays are moved either horizontally or vertically, the new installations will require only a simple unbolting and re-bolting. This basic support structure should be standardized throughout the airport to provide a common appearance, while still allowing the basic structure to be customized to more closely match the specific architectural characteristics of each location.

Whether text is displayed vertically or horizontally, in a single row configuration, the text reads left to right. In multiple row configurations, the text reads up/down in each column, then to next column to the right.

7.2.6 Readability of Text for FIDS

ANSI/HFS 100-1988, Paragraph 6.14.2⁶¹ provides a formula to calculate text height for readability. Using the formula, the text height for readability at a distance of 20' (240") would need to be 1.1 inches high, say 1" high.

7.2.7 Departure vs. Arrivals MUFIDS Information

Figures 7.1 and 7.2 illustrate typical information to be displayed at the departures and arrivals locations. The destination/origin cities and remarks could be shown in multi-national text. The multi-national text would be toggled sequentially among several different languages. Multi-national language applications may not be applicable to all airports.

Recommended order of information displayed by column is origin/departure city; airline; flight number; code share airline (airline and code share airline may be displayed as a fade-in/fade out configuration); flight number; gate number; time of arrival/departure; and status remarks (on-time, delayed, landed, cancelled, etc.).

Time window for display of information—The desired time window is one of the most critical factors in determining the number of displays required in a MUFIDS display bank. This factor is driven by how long prior to/after departure and arrival information should be shown on the MUFIDS. Typically, the following time window goals for information displays have been identified:

- Domestic departures—3 hours prior to + 0.5 hours after departure.
- International departures—4 hours prior to + 1 hour after departure.
- Domestic arrivals—2 hours prior to + 1 hour after arrival.
- International arrivals—3 hours prior to + 2 hours after arrival.

Information displayed will include city (departing to or arriving from—if international, may include multi-lingual descriptor); the carrier and flight number (carrier may be airline logo, airline name, and/or combination of both); code share carrier and flight number; gate number; time; and remarks (remarks include flight status such as on-time, landed, and cancelled); and may be multi-national text.

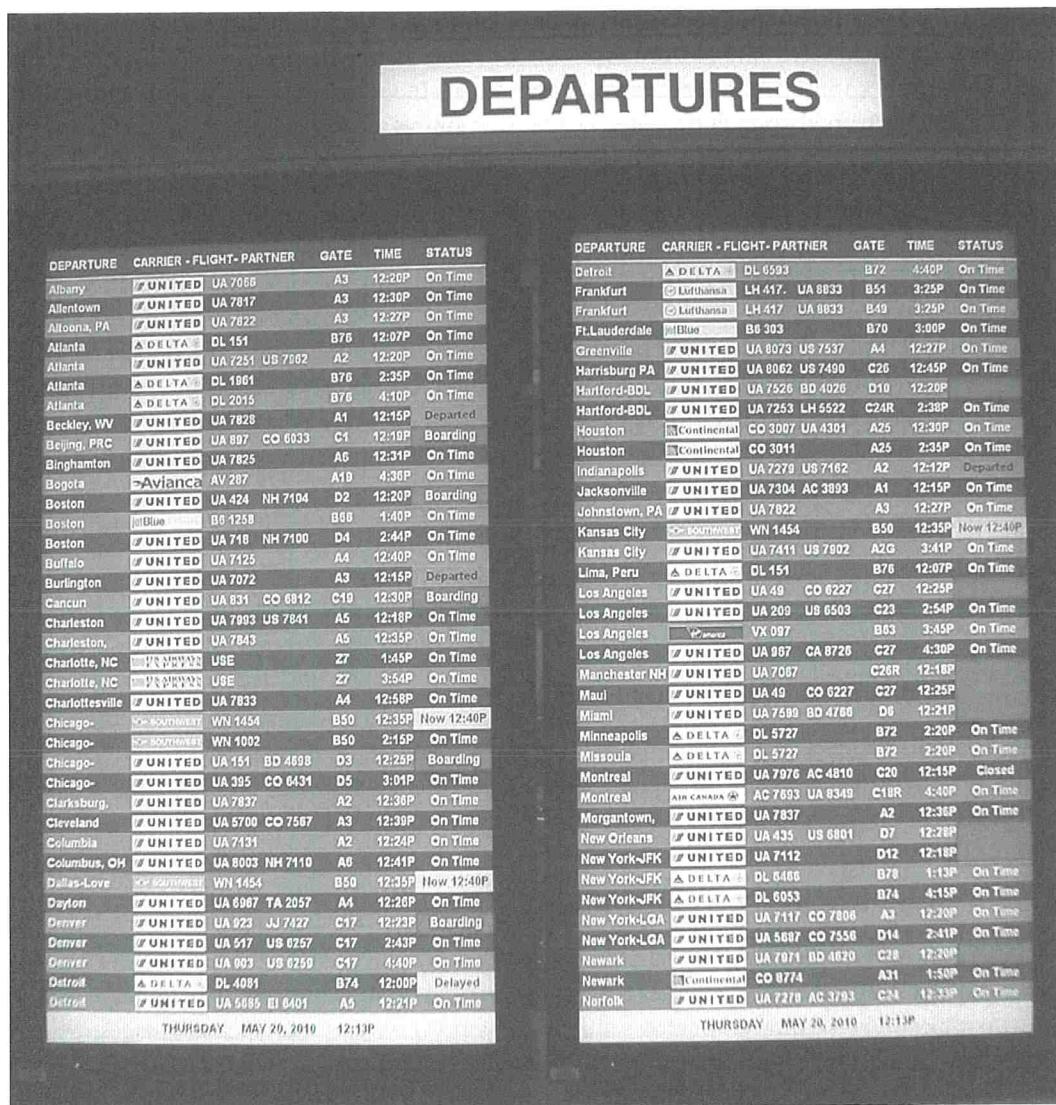


Figure 7.1. Sample departures display—Dulles International Airport (IAD).

Ideally, each MUFIDS display will convey flight information for all types of operations (e.g., international departures, international arrivals, domestic departures, and domestic arrivals). However, space constraints may limit the amount of information displayed. In those areas where space is limited, consideration may be given to varying the type of information presented at each MUFIDS display bank. For example, international arrivals information may not need to be displayed at concourses dedicated to domestic arrivals only.

7.2.8 Visual Paging

The MUFIDS may support visual paging capabilities. Such visual pages can be entered manually from designated MUFIDS workstations, such as those located at the Travelers Aid desks. Depending upon system configuration, such pages can temporarily occupy a complete or partial area on a designated MUFIDS display in selected display group locations, can appear as a scrolling marquee at the bottom of one or more displays, or be displayed on a separate stand-alone display.

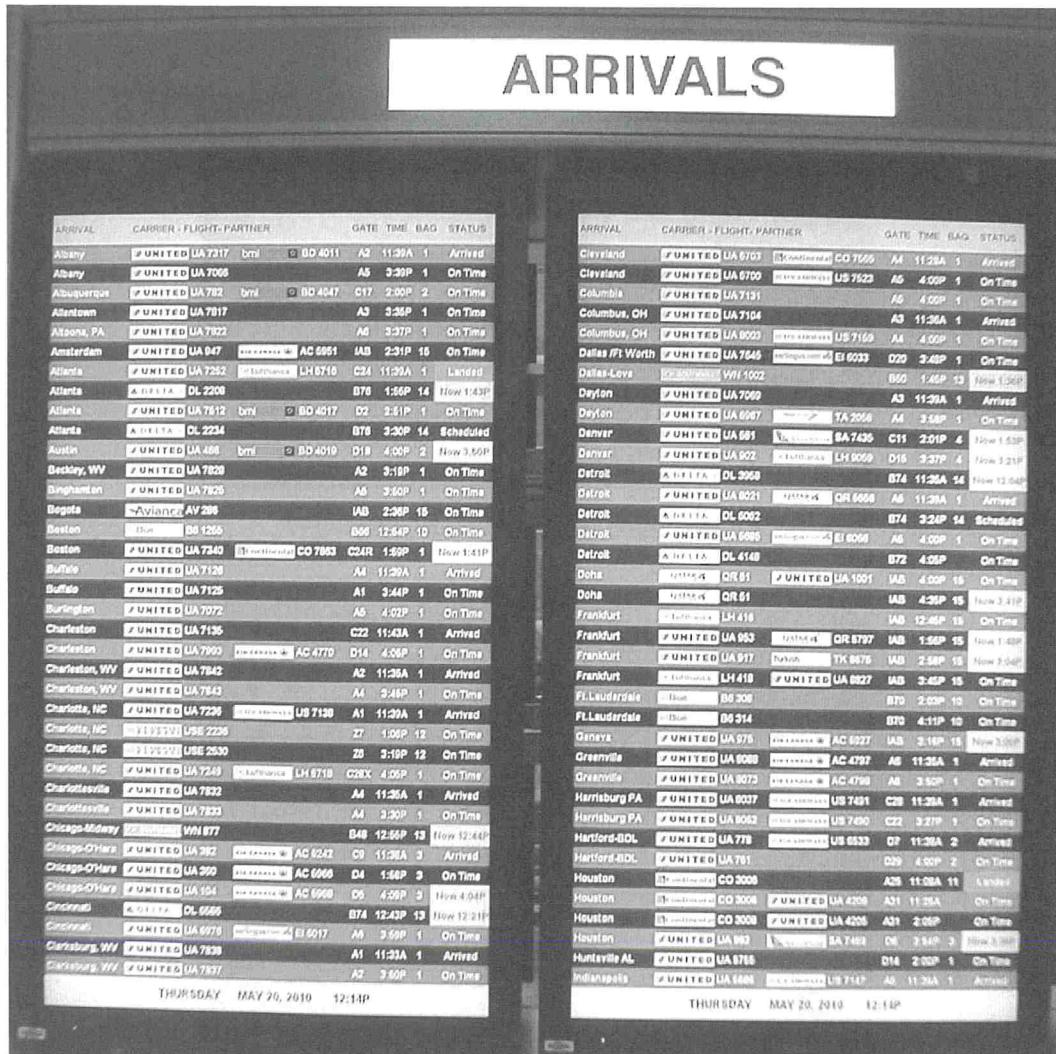


Figure 7.2. *Sample arrivals display—IAD.*

Figure 7.3 shows an example of a stand-alone visual paging display currently installed at San Francisco International Airport (SFO). Figure 7.4 shows an example of a Paging Assistance Location (PAL) to retrieve a message at the Phoenix Sky Harbor International Airport (PHX).

Although Visual Paging functionality is typically provided in the MUFIDS software, this functionality may be unused, since the visual paging function may be supported by dedicated displays provided as part of the public address system. One of the strengths of the public address system is that visual and audio pages can be synchronized. This is a feature that cannot be easily accomplished if the MUFIDS were used for visual paging.

However, the use of MUFIDS displays for visual paging does offer certain advantages including the following:

- MUFIDS displays provide all necessary infrastructures to support visual paging functions for little additional costs.
- Passengers with hearing disabilities normally have their attention drawn to such displays as part of the normal wayfinding through the airport.

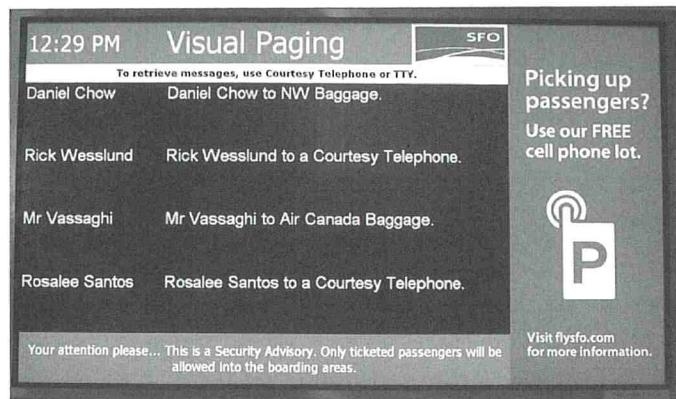


Figure 7.3. Sample visual paging display—SFO.



Figure 7.4. Sample paging assistance location—PHX.

- When not in use for visual paging, designated visual paging displays could display alternate information such as additional flight information, way-finding information, and advertising.

If interest in accomplishing visual paging is through MUFIDS implementations, decisions are needed as to whether this will be accomplished on dedicated displays. This could potentially impact the total number of displays required at each location.

7.2.9 Integration with MUFIDS

So that the various systems (e.g., CUTE/MUSE, Paging, or CUSS) will “talk” to each other, establish software requirements for an API (Application Programmer Interface) such that external modules can be integrated into the MUFIDS to meet specific requirements and needs of the integration and the Airport.

7.2.10 Ticketing Area Displays

In an airport, there are two types of ticket counters identified: dedicated airline ticket counters (e.g., those utilized by only one airline) and common-use ticket counters (e.g., those positions equipped with CUTE/MUSE terminals that can be utilized by any airline). The following section provides recommendations for MUFIDS displays at these two types of ticket counters and includes information for backwall displays, over-the-counter displays, and common-use self service check-in.

7.2.11 Dedicated Ticket Counter Positions

An airline typically wants to be able to provide passengers with information about its flights right at the airline ticket counter. Some airlines at the airport have this currently (e.g., FIDS displays on the backwall of the ticket counter), although there appears to be no consistency or standards about where and how this information is shown. Depending on the amount of flight traffic, this may require multiple displays for arrivals and departures, or might be a single monitor that shows both arrivals and departures for that airline. These monitors are typically located on the backwall behind the ticket counter locations.

Above selected ticket counters, there may be two-line LED signs or flat panel displays that are used to direct the passenger to the correct ticket counter line; (e.g., First Class Only, Elite Members, “Ticket Purchase,” “Check-in,” etc.) These signs should be under the control of MUFIDS, although the individual ticket agent would have the ability to change the contents of these displays based on the current need.

7.2.12 Common-Use Ticket Counter Positions

Common-use ticket counter positions are becoming more prevalent. Such positions should have MUFIDS display needs similar to that of the dedicated positions, with the following exceptions:

- At common-use ticket counter positions, MUFIDS should support backwall displays for airline logos and airline-specific flight information. Because positions are to be common-use, there exists a need to associate a given position with a given airline. It is recommended that this be accomplished via a dedicated display in the backwall that can dynamically display the corresponding airline logo.
- To support those airlines that may desire their flight information to be displayed at a ticket counter, a second display should be provided in support of such information. Depending on the amount of flight traffic, this may require multiple displays for arrivals and departures, or might be a single monitor that shows both arrivals and departures for that airline.

- At common-use ticket counter positions, MUFIDS should support LED signs or flat panel displays above the ticket counter position.
- Given that there will be a CUTE/MUSE terminal at such locations, controls for the backwall displays and the over-the-counter displays can be done via a MUFIDS session on the CUTE/MUSE terminal.

7.2.13 Common-Use Self Service (CUSS) Kiosks

For passengers with no baggage to check-in, CUSS kiosks may be located at the entrances to the Terminal or at the pedestrian exits of the parking garages. These are intended to provide a boarding pass so that passengers can proceed directly to passenger screening.

For passengers checking baggage, the CUSS kiosks are located in front of the airlines ticket counter. The passengers access the CUSS terminal using a credit card, which brings up a display identifying the passenger, confirms the destination city, asks how many bags are being checked, asks whether a seat change is desired, and issues the boarding pass. The passenger then waits to be called by the airlines representative to come forward to check in the bags.

7.2.14 Departure Area Displays

Although not a fully comprehensive list, various types of displays and locations for these displays in Gate Holdroom Areas are described in the following sections.

7.2.15 Standards for Gate Podium Displays

It is understood that an Airport desires the development of standardized design criteria for the various types of gate podiums. These standards will be applied to all future gate podium installations and may be applied to existing podiums subject to budgetary constraints. While such standards can only be fully developed as part of a design effort, this guideline identifies basic recommendations that can serve as the basis for future design efforts.

As a general recommendation, consideration should be given to the use of flat panel backwall displays to convey information relevant to the next flight departing the gate.

While such displays would be under the control of MUFIDS, local manual control would be supported via CUTE/MUSE workstations within the limits of the airline representative's authorization.

MUFID software should be capable of dynamically changing the displays at gates in support of various types of operations based upon schedules and operator actions (e.g., the gate podium designated as Multi-Use International can easily be changed via the MUFIDS software to be a Dedicated Domestic gate).

7.2.16 Multi-Use Commuter Gates

Multi-use commuter gates serve commuter flights where the commuter flights are potentially for different commuter carriers. Due to the nature of commuter operations, there may be a need to display a large number of flights associated with a given airline/gate. In addition, displays should accommodate code share information. Consequently, consideration should be given to larger or multiple displays to convey the necessary flight information.

At multi-use commuter gates, the gate backwall should have a display device to display the status of the flights associated with the gate. For commuter airlines, this may require a large number of flights to be displayed. Because this gate is to be designated for multiple-use, consideration

should be given to installing a separate display for the purpose of displaying the airline logo for the commuter airline currently at the gate.

Due to the potentially significant amount of information to be conveyed by the backwall displays (e.g., numerous flights), it may prove beneficial to also provide a separate LED sign to convey current activities (e.g., A NOW BOARDING FLIGHT . . .@). Due to the information which needs to be shown regarding flights leaving at approximately the same time, the LED sign may show only a line of information per flight, instead of using the entire LED to show detailed information about a single flight. Although the details of the requirements for the LED signs at these gates would be further defined in the design phase, our analysis is that the LED signs may need to be larger than the LED signs typically used so that additional lines of information can be displayed simultaneously.

As opposed to providing a separate display for airline logo images, optional consideration should be given to screen designs which feature airline logos in the background with flight information superimposed over the top.

7.2.17 Dedicated Commuter Gates

Dedicated commuter gates serve commuter flights from the same commuter carrier. MUFIDS requirements for such gate podiums are identical to that of the multi-use commuter gate podiums with the exception that there is no need for a display for airline logos.

At dedicated commuter gates, the gate backwall should have a display device to display the status of the flights associated with the gate. For commuter airlines, this may require a large number of flights to be displayed.

At dedicated commuter gates, the video controllers in the display banks and gate podium backwalls should be capable of full-motion video (e.g., to display video advertising), although it may not be utilized at initial implementation.

At dedicated commuter gates, a separate LED sign should be provided to convey information about current and near-term flight activities.

7.2.18 Multi-Use Domestic Gates

Multi-use domestic gates serve regular domestic flights from multiple carriers. As compared to commuter airline gates, backwall displays should be required to only display modest flight information. However, consideration should be given for the display of code sharing and multiple destination flights.

Because this gate is designated as multiple-use, consideration should also be given to installing a separate display for the purpose of displaying the airline logos for the airline currently served by the gate.

As opposed to providing a separate display for airline logo images, optional consideration should be given to screen designs which feature airline logos in the background with flight information superimposed over the top.

7.2.19 Dedicated Domestic Gates

Dedicated domestic gates serve regular domestic flights from the same carrier. MUFIDS requirements for such gate podiums are identical to that of the multi-use domestic gate podiums with the exception that there is no need for a separate display for airline logos.

At dedicated domestic gates, the gate backwall should have a display device to display the status of the flights associated with the gate.

7.2.20 Multi-Use International Gates

Multi-use international gates serve regular international flights from multiple carriers. MUFID requirements for such gates should be similar to that of multi-use domestic gate podiums with the exception that the flight displays should be designed to support foreign languages in addition to English. Such foreign language requirements create a strong argument for flat-screen displays, as opposed to LEDs, due to the need for higher resolution graphics required to support foreign language characters.

As opposed to providing a separate display for airline logo images, consideration should be given to screen designs which feature airline logos in the background with flight information superimposed over the top.

7.2.21 Dedicated International Gates

Dedicated international gates serve regular international flights from the same carrier. MUFIDS requirements for such gate podiums are identical to that of the multi-use international gate podiums with the exception that there is no need for a separate display for airline logos.

7.2.22 Jet Bridge Door Signage

Jet bridge door signage is a small electronic device, typically a two-line LED sign or flat panel display, which indicates the flight number and the destination city. This sign is located in the hold room area just above the jet bridge door. This type of sign provides passengers with a final glance at information about the flight that they are about to board, to ensure that they are boarding the correct flight.

7.2.23 BIDS (Baggage Information Display System)

Figure 7.5 shows what could be a typical display in the Baggage Claim area. Note, the baggage carousel or baggage belt number will typically be shown on all “Arrivals” displays.

BIDS displays should be located within the baggage claim area and the meeters/greeters hall. A small bank of such displays should be located at each primary entrance to the baggage claim area, and these displays should show flights that have recently arrived or will be arriving in the near future. These should serve as baggage claim directories, and should show the airline(s); flight number(s); origin city name(s); time of arrival, flight status (e.g., on-time, landed, delayed, cancelled); and the baggage carousel or baggage belt number being used for the flight.

Other baggage claim display types may be located at each carousel and/or baggage belts to confirm the airline, flight number, and/or city being unloaded on the carousel or baggage belt. These same displays may be used for video advertising and/or may show local interest information (places to visit, airport construction progress, and other similar items) when not actually in use. Additionally, a “last bag” indication may be displayed to show that all baggage has been unloaded.

7.2.24 BIDS Location

BIDS are located inside the baggage claim area near the primary passenger entrances and, dependent upon the size of the baggage claim area, may be located at 250-foot intervals along the front of the carousels and/or baggage belts. Additional displays may be desired in the baggage claim

ARRIVALS							
ARRIVAL	CARRIER - FLIGHT - PARTNER	GATE	TIME	BAG	STATUS		
Albany	UNITED UA 7317 bml	BD 4011	A2 11:30A	1	Arrived		
Albany	UNITED UA 7068		A3 2:30P	1	On Time		
Albuquerque	UNITED UA 782	bml	BD 4047	C17 2:00P	2	On Time	
Allentown	UNITED UA 7817		A3 3:30P	1	On Time		
Allisons, PA	UNITED UA 7322		A6 3:37P	1	On Time		
Amsterdam	UNITED UA 047	AC 6661	WB 2:31P	16	On Time		
Atlanta	UNITED UA 7282	LH 6718	C24 11:30A	1	Landed		
Atlanta	AIRLINES DL 2208		B74 1:56P	14	Now 1:43P		
Atlanta	UNITED UA 7812	bml	BD 4017	D3 2:51P	1	On Time	
Atlanta	AIRLINES DL 2234		B74 3:30P	14	Scheduled		
Austin	UNITED UA 496	bml	BD 4019	B18 4:00P	2	Now 3:59P	
Beckley, WV	UNITED UA 7828		A2 3:18P	1	On Time		
Binghamton	UNITED UA 7828		A6 3:30P	1	On Time		
Bogota	AIRLINES AV 298		IB 2:30P	15	On Time		
Boston	UNITED UA 1256		B46 12:54P	10	On Time		
Boston	UNITED UA 7240	CO 7863	C24R 1:50P	4	Now 1:41P		
Buffalo	UNITED UA 7128		A4 11:30A	1	Arrived		
Buffalo	UNITED UA 7125		A1 3:44P	1	On Time		
Burlington	UNITED UA 7072		A6 4:02P	1	On Time		
Charleston	UNITED UA 7135		C22 11:43A	1	Arrived		
Charleston	UNITED UA 7992	AC 4770	D14 4:06P	1	On Time		
Charleston, WV	UNITED UA 7842		A2 11:30A	1	Arrived		
Charleston, WV	UNITED UA 7942		A4 3:45P	1	On Time		
Charlotte, NC	UNITED UA 7226	WB 7130	A1 11:30A	1	Arrived		
Charlotte, NC	UNITED UA 8226		Z7 1:30P	12	On Time		
Charlotte, NC	UNITED UA 2530		Z8 3:10P	12	On Time		
Charlotte, NC	UNITED UA 7249	LH 6718	C25X 4:26P	3	On Time		
Charlottesville	UNITED UA 7322		A4 11:30A	1	Arrived		
Charlottesville	UNITED UA 7833		A4 3:30P	1	On Time		
Chicago-Midway	UNITED UA 877		B46 12:58P	13	Now 12:47P		
Chicago-O'Hare	UNITED UA 392	AC 6242	C9 11:30A	3	Arrived		
Chicago-O'Hare	UNITED UA 262	AC 6968	D4 1:56P	3	On Time		
Chicago-O'Hare	UNITED UA 164	AC 6968	D6 4:09P	3	Now 4:08P		
Cincinnati	AIRLINES DL 6566		B74 12:43P	19	Now 12:41P		
Cincinnati	UNITED UA 6975	EB 6017	A6 3:59P	1	On Time		
Charleston, WV	UNITED UA 7828		A1 11:30A	1	Arrived		
Charleston, WV	UNITED UA 7837		A2 3:30P	1	On Time		

ARRIVAL	CARRIER - FLIGHT - PARTNER	GATE	TIME	BAG	STATUS		
Cleveland	UNITED UA 8703	CO 7866	A4 11:28A	1	Arrived		
Cleveland	UNITED UA 6700		US 7623	A6 4:00P	1	On Time	
Columbus	UNITED UA 7191		A6 4:00P	1	On Time		
Columbus, OH	UNITED UA 7104		A3 11:36A	1	Arrived		
Columbus, OH	UNITED UA 8003		US 7159	A4 4:00P	1	On Time	
Dallas/Ft Worth	UNITED UA 7646	EB 6033	D20 2:48P	1	On Time		
Dallas-Love	UNITED VN 1022		B60 1:45P	43	Now 1:39P		
Deyton	UNITED UA 7000		A3 11:39A	1	Arrived		
Deyton	UNITED UA 6967		TA 2056	A4 3:58P	1	On Time	
Denver	UNITED UA 6861		SA 7435	C11 2:51P	4	Now 1:53P	
Denver	UNITED UA 802		LA 9059	D16 3:37P	4	Now 3:39P	
Detroit	AIRLINES DL 2068		B74 11:36A	44	Now 12:44P		
Detroit	UNITED UA 6921	DL 6866	A6 11:26A	3	Arrived		
Detroit	AIRLINES DL 8062		B74 2:24P	44	Scheduled		
Detroit	UNITED UA 6966	EB 6096	A6 4:00P	1	On Time		
Detroit	AIRLINES DL 4148		B72 4:05P		On Time		
Doha	QATAR QR 61	UNITED UA 1001	A6 4:00P	16	On Time		
Doha	QATAR QR 61		A6 4:36P	16	Now 4:37P		
Frankfurt	UNITED UA 6118		A6 12:46P	18	On Time		
Frankfurt	UNITED UA 963	DL 5797	A6 1:56P	15	Now 1:53P		
Frankfurt	UNITED UA 917		TK 8076	IA8 2:58P	16	Now 3:04P	
Frankfurt	UNITED UA 4419	UNITED UA 8227	A6 2:45P	16	On Time		
FL-Lauderdale	UNITED BA 306		B70 2:03P	10	On Time		
FL-Lauderdale	UNITED BA 314		B70 4:11P	10	On Time		
Geneva	UNITED UA 976	AC 6927	IA8 3:16P	18	Now 3:09P		
Greenville	UNITED UA 8088	AC 4797	A6 11:36A	1	Arrived		
Greenville	UNITED UA 8073	AC 4798	A6 3:50P	1	On Time		
Harrisburg PA	UNITED UA 8037	US 7481	C22 11:36A	1	Arrived		
Harrisburg PA	UNITED UA 8043	US 7480	C22 3:27P	1	On Time		
Hartford-BDL	UNITED UA 778	US 6633	CF 11:36A	2	Arrived		
Hartford-BDL	UNITED UA 791		C29 4:00P	2	On Time		
Houston	UNITED CO 3008		A26 11:36A	11	Landed		
Houston	UNITED CO 3008	UNITED UA 4208	A31 11:36A		On Time		
Houston	UNITED UA 862	SA 7468	C6 3:48P	3	Now 3:50P		
Huntsville AL	UNITED UA 8768		D14 2:05P	1	On Time		
Indianapolis	UNITED UA 9406	US 7147	A6 11:36A	1	Arrived		

Figure 7.5. Sample baggage information display.

to show directions to and location of airline baggage offices and the location for over-sized baggage pick-up.

7.2.25 Dynamic Directories

In lieu of static “you are here” map directories, consideration should be given to the use of dynamic map directories. This is because displays are now available in large size screen formats with high definition resolution. These types of displays can contain a significant amount of wayfinding information. The rationale for using this type of display is that all changes in the architectural layout of an airport can be easily modified on the display by downloading the graphical layouts from a central location without the need to replace a static directory each time a change to the facility is made.

Options for digital applications for directories continue to evolve. Digital directory applications can be separated into two basic categories: passive and interactive. Passive digital directories display a static image using a flat screen monitor. Interactive directories allow users to search for information using touch screen panels. While there is no established best practices, the following is a list

of five considerations airports should address when considering integration of interactive wayfinding into their overall directional wayfinding schema.

Map-driven vs. intent-driven organization of wayfinding content. One of the biggest opportunities in the market is to orient the content towards the viewers' specific needs. For instance, present all Points of Interest (POI) available in an airport concourse property, such as emergency, medical, or administration vs. POI for specific passenger needs such as Quick Serve Restaurants (QSR) and other Retail concessionaires. It may be a better use of resources to reserve Interactive Wayfinding for more heavily searched POI such as concessionaires.

The efficiency of a singular user experience vs. a multi-user experience. Airport patrons have become accustomed to interactive experiences delivered via kiosk, be it check-in or rental car, while they have traditionally digested directional and wayfinding information in a much less intimate manner through static signs and large, printed public display maps. Questions to answer: If a large format screen is programmed to provide wayfinding information, will people use it? Does its size leave people feeling exposed, knowing that others may "eavesdrop" as to what they are looking for? Is wayfinding more aptly handled in the manner of current interactions via kiosk? If so, how do you encourage the general public to interact with them?

Management of interactive wayfinding systems. Printed wayfinding signs have traditionally proven to be costly and have very limited life cycles. And while digital signage and Interactive Wayfinding are significant steps in alleviating some of those costs, administrators should realize and appropriate resources for continued management of these systems. Manufacturers, resellers, or agencies that provide design and content management services should be favored when weighing these considerations. Systems that also offer the simplicity and flexibility of being managed by Airport Staff should also be given weighted consideration.

Using an interactive wayfinding system as a value-add or revenue generating mechanism. Investment in interactive wayfinding is not an inconsequential expenditure. How do Airport Administrators maximize that investment and shorten the ROI realization term? Diligent interactive wayfinding systems will allow for value added options like wireless coupons or ad driven content. Administrators can also take advantage of interaction metrics that are reported back by the digital signage system. These metrics can be used to improve user interface design, spot search trends (for use in facility planning, i.e., where to place more amenities), and to discover hidden user behavior patterns.

Buying vs. leasing an interactive wayfinding system. Today, more progressive agencies and manufacturers realize the Moore's law-type effect associated with technology and hardware: what's cutting edge this year, may be obsolete two years after implementation. So how do airports protect themselves from this effect? More and more end-users are electing to lease equipment for terms of 3–5 years, depending on use. The market will begin to see more facilities elect for lease options that allow them to return equipment at the end of limited terms in exchange for updated equipment. The service model will continue to trend towards a Software as a Service (SaaS) model that has been popularized within other business markets. See Section 6.4.1.2 for additional information on digital directory applications.

7.2.26 Interactive Systems

In the interest of expanding customer service, airports have expressed interest in expanding the existing MUFIDS beyond its current boundaries (e.g., to parking garages, rental car facilities, nearby hotels, etc.).

As previously discussed, the amount of information required to be presented by the MUFIDS decreases as a passenger approaches their destination (e.g., boarding gate, bag claim device, etc.).

The opposite is also true—the potential amount of information needed is increased the further from the airport passengers are located. Obviously, it is not practical to install massive numbers of displays at these remote locations. To address this issue, there are a number of options available as shown in the paragraphs below.

7.2.27 Flight Information Kiosks

To resolve the ever-increasing need to provide passengers with information on demand, some airports have elected to implement “passenger information kiosks” to help provide timely, needed information. These kiosks typically have a touch-screen interface providing a convenient opportunity for passengers to obtain pertinent information from the MUFIDS. In addition to flight information, the kiosks can provide additional information about hotels, rental cars, tourist attractions, restaurants, airport services, wayfinding, etc. The flight information presented at these kiosks can be obtained from on-line services or the Airport’s website (via internet) or through a network connection with the Airport’s MUFIDS (requires local network connection).

There are a number of sources for such kiosks. These units can leverage upon existing communications infrastructure or operate in a wireless environment, if available.

7.3 Design Elements

7.3.1 Regulatory Requirements—ADA and Display Systems

The flexible software of a modern MUFIDS and/or wayfinding signage controller system enables the user to display data to disadvantaged passengers and to comply with any ADA requirements which may in the future be mandated by local or Federal laws. An example is displaying visual paging messages on designated monitors.

Because MUFIDS displays are dynamic in nature, they normally are considered temporary signs and, therefore, are not specifically addressed under ADA. It is in the public interest, however, that any new wayfinding and signing system accommodate and anticipate ADA-type display features during the design phase. Each display bank should consider the inclusion of provisions for the future addition of TDD phones.

7.3.2 Sign Lighting Controllers (Dimming, Groups of Signs)

Controls for sign lighting typically is provided as part of the wayfinding and signing system software. The control of the lighting can be set by individual sign or by groups of signs either manually and/or via an automatic time program. Sign lighting may also be automatically controlled locally at each sign with photoelectric cells.

7.4 Open System Architecture

System architecture constitutes the framework that describes how system components interact and work together to achieve total system goals. It describes the system operation, what each component of the system does, and what information is exchanged among the components. System architecture may be either “open” or “closed.”

System equipment should be installed that support “open” system architecture standards and protocols to allow the use of several different manufacturers’ systems and devices that support an

“open” system architecture to provide interoperability, compatibility and interchangeability within the wayfinding and signing system. This allows a facility to establish multi-source, “common-off-the-shelf” (COTS), and industry standards for all components and network devices.

7.4.1 System Testing

Establish test beds to support full testing of any new software, firmware and hardware. Test beds shall support the full testing of components in actual and simulated environments to identify and eliminate problems that may cause system instability prior to its actual implementation.



CHAPTER 8

Code Required Regulatory and Information Signs

This chapter contains an overview of the regulatory and informational signs required by code to be posted in airports, primarily in the terminal areas. These codes as well as the governing agencies are subject to change. Therefore, airports should periodically review the most current code requirements. The information listed in this section is current as of the publication date of this guideline.

8.1 Federal Agencies

Regulatory agencies are described below in the following sections.

8.1.1 Department of Homeland Security (DHS)

One component of the Department of Homeland Security is the Transportation Security Administration (TSA). TSA protects the nation's transportation systems to ensure freedom of movement for people and commerce. Since 2001, TSA has been mandated by law to appropriately screen air travelers to ensure that certain items and persons prohibited from flying don't board commercial airliners. TSA officers are most visibly present at over 450 airports across the country where passengers must pass through security checkpoints to access the departure gate, and where Security Officers screen passengers and their carry-on baggage.

TSA sign requirements are subject to change without notice. Specific requirements can be found in the most recently published TSA Airport Signage Guidelines. The Assistant Federal Security Directors responsible for security compliance and customer service should be contacted for latest guidelines and how those guidelines are applied to the specific airport. The five primary types of TSA airport signage are:

- Checkpoint Signage,
- Campaign Signage,
- Checked Baggage Signage,
- Direct Access Point Signage, and
- Technology Signage.

U.S. Customs and Border Protection (CBP) is another component of the Department of Homeland Security. Signage required by CBP is identified in the document Airport Technical Design Standards—Passenger Processing Facilities dated August 2006. In addition, CBP required signage includes currency reporting.

8.1.2 Code of Federal Regulations (CFR)

This is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government. The CFR is divided into 50 titles that represent broad areas subject to Federal regulation. Two are referenced in this document:

Title 14: Aeronautics and Space (also known as the Federal Aviation Regulations (FAR), administered by the Federal Aviation Administration)

Title 49: Transportation

Examples of regulatory signage under the CFR includes:

- Passenger Rights (limitation of liability, overbooking of flights)
- Security (threat advisory, consent to search, X-Ray system, false statements)
- Transportation of Materials (Hazardous materials, firearms)
- Passenger Notices (tariffs, notice of contract)
- Unlawful Discrimination

8.1.3 United States Code (USC)

The Office of the Law Revision Counsel prepares and publishes the United States Code, which is a consolidation and codification by subject matter of the general and permanent laws of the United States. The Code does not include regulations issued by executive branch agencies, decisions of the Federal courts, treaties, or laws enacted by State or local governments. Regulations issued by executive branch agencies are available in the Code of Federal Regulations.

8.2 Americans with Disabilities Act Accessibility Guidelines (ADAAG)

Reference Chapter 6 accessibility Section 6.8 for information related to the ADA. The ADAAG contains scoping and technical requirements, including signage, for accessibility to buildings and facilities by individuals with disabilities under the Americans with Disabilities Act (ADA) of 1990. These scoping and technical requirements are to be applied during the design, construction, and alteration of buildings and facilities covered by Titles II and III of the ADA to the extent required by regulations issued by Federal agencies, including the Department of Justice and the Department of Transportation, under the ADA.

State accessibility requirements and standards for ADA signage should also be consulted. In some cases, state requirements may be stricter than federal requirements.

8.3 Federal Highway Administration (FHWA)

As previously noted in Chapter 3, airports should refer to the Federal Highway Administration's Manual of Uniform Traffic Control Devices for rules and regulations associated with airport roadway signing. Airports will also need to look at their individual state manuals.

8.4 State and Local

Airports may be required to post state mandated signs and notices. One example is California Penal Code Section 602 which requires posting of a notice of prosecution for unauthorized entry, located prior to entry to airport operations areas. Due to the variety of state requirements, this

document cannot list these signs and instead recommends consultation with agency attorneys and airport operations staff.

Local agencies may also provide signage requirements. For example, water recycling agencies may require posting of signs that identify use of recycled water in irrigated areas and the use of recycled water in restrooms.

8.5 Other Code and Regulating Agencies

Published building codes and agencies that publish code and standards include the following:

- ANSI American National Standards Institute
- ASME American Society of Mechanical Engineers
- NFPA National Fire Protection Association
- IBC International Building Code
- NEC National Electric Code
- SBCCI Standard Building Code
- UBC Uniform Building Code
- The various building codes have a variety of sign requirements applicable to airports. A few examples include the following:
- Signs for escalators or moving walkways including restrictions of other signs in these areas (ASME A17.1);
- Signs for automatic sliding doors (ANSI);
- Fire evacuation maps (various codes);
- Fire Exit signs (various codes); and
- Stair identity (various codes).
- Local building and fire officials should be consulted when reviewing or developing signs required by building and fire codes or standards.

8.6 Regulatory and Informational Signage Required by Federal Regulations

Elements included or addressed in this section include the following:

- Federally required signs, typically in compliance with the Code of Federal Regulations (CFR) and
- Transportation Security Administration (TSA) requirements at ticketing and check-in areas, curbside check-in, security checkpoint, and gate hold rooms. Requirements come from current security directives or required per TSA signage guidelines.

Elements not included in this section:

- TSA requirements for signs at portals to operational or sterile areas,
- State-specific requirements, and
- Building code requirements.

8.6.1 Security Checkpoint

The TSA has specific requirements regarding security checkpoint signs, as outlined in the document TSA Airport Signage Guidelines (dated February 2010)⁶².

About this document:

- The guidelines describe required signage through the checkpoint with specific sign sizes and locations.

- The assumption is that the non-required signs are negotiated with the airport for placement, such as seasonal messages or campaign signage.
- The document is not clear on how to address separate lines such as a crew line, accessible line, first class/priority customer line, or registered traveler line. Without any guidance, the assumption is these lines need to display the same information. To avoid a sea of signs over the checkpoint, sign planning must consider weaving these separate lines through the main queue lines to ensure that all groups pass through the area of required signs.
- The guidelines do not address signs for the family lane/business lane/black diamond lane concept used at checkpoints. If separate line queues are developed, then planning is necessary to ensure all these groups pass the TSA required signs without the need to add more signs into the queues.

Checkpoint sign plans need to be developed and specific to the checkpoint operations to ensure that TSA signage requirements are met and objectives stated. Those responsible for airport operations must also understand TSA signage requirements and be prepared to address the situation where there may be no backup into the checkpoint, but all travelers must still pass TSA signage (versus a shortcut that takes them directly to the front of the line).

8.6.2 Signage Requirements

Figure 8.1 is a table of all known federal regulatory and informational signage requirements at airport terminals, requirements and recommendations for posting. This includes TSA require-

TABLE: FEDERAL REGULATORY AND INFORMATIONAL SIGNAGE

Primarily for Airport Terminals. Refer to the document *Regulatory and Informational Signage Required by Federal Regulations*, by Mineta San Jose International Airport, for sign details and specific information.

REFERENCE	Font Specified	WHERE TO BE POSTED				NOTES and RECOMMENDATIONS	
		Curb	Ticketing	Gate	Self Check-in		
Passenger Rights							
Notice of Limitation of Liability for...							
- Death/Holiday - Baggage Liability - <u>OR</u> Combo Statement - both items above	14 CFR 221.105 14 CFR 221.105 (a)(1) 14 CFR 221.105 (a)(2)	Boldface type, 0.25 in	x	x	x	Use the combined statement. CFR quote specific - no airline specific requirements. Note that Title 24, Part 254.5 requires baggage liability statement on the printed ticket - in fact, if terms change, the printed ticket takes precedence. If airline requires specific language, they can add to the printed ticket per Title 24 requirement. At Self check-in not required... tickets are not issued, just boarding passes.	
Overbooking of Flights	14 CFR 250.11	Boldface type, 0.25 in	x	x	x	CFR quote specific. No airline specific requirements.	
Security / TSA							
TSA Checked Bag Combo	TSA Airport Signage Guidelines	N/A	x	x		The Checked Bag Combo sign is required by the TSA Airport Signage Guidelines	
TSA Liquids - Revised	Security Directive 1544-06-01D	N/A	x	x		Use revised TSA Liquids Combo sign to meet security compliance message requirements. Refer to details explained in document <i>Regulatory and Informational Signage Required by Federal Regulations</i>	
National Threat Advisory (includes notice to Keep all bags with you)	Security Directive 1544-08-01D	No	x	x			
Consent to Search/ Passenger Identification (Subject to Search; Screening of Checked Baggage; Present Valid form of ID)	49 CFR 1540.107 Aircraft Operator Security	No	x	x	x	No specific language to post. Requirement due to security plans and reviewed by TSA regulatory personnel. Also note TSA document "Aviation Direct Access Screening Program (ADASP) SOP."	
False Statements	Applied related to 49 USC 48007	No	x	x	x	There is no requirement to post, but may be required by air carrier or TSA	
Use of X-Ray Systems	49 CFR 1544.211	No	x	x		Required to post.	
Transportation of Materials & Currency							
Transportation of Hazardous Materials	49 CFR 175.25	First line: 0.40 in All else: 0.16 in	x	x	x	x	CFR quote specific. No airline specific requirements.
Transportation of Firearms	49 CFR 1544.203(f)	No	x	x			This part says "Each aircraft operator must ensure that...," but no specific language to post. Requirement to include is obvious. Recommend inclusion using exact language as given in this part of the CFR. Note also that TSA Airport Signage Guidelines also offer the option for the Firearms Declaration sign, though not a requirement to post.
Currency Reporting	CBP Website	No	x	x			The CBP has a specific requirements, primarily directed to international travel, and it provides a poster. There is no requirement to post the information, and no requirement to use the specific poster. The CBP information is recommended to be incorporated in the ticket quote or check-in areas.
Passenger Notices							
Public Inspection of Tariffs OR Explanation of Contract Terms	14 CFR 221.103 OR 14 CFR 221.107	Large type (not defined)	x	x	x		CFR quote specific. At Self check-in not required... tickets are not issued, just boarding passes.
Notice of Contract/ Incorporated Terms	14 CFR 253	No					Not required to be posted. Not even advised to be posted at the airport terminal ticketing or curb areas. It is absolutely required to be printed on ticket. Requires review with airlines
Other							
Unlawful Discrimination	49 CFR 21 Appendix C	No	Posted in main public area of airport				States to "...conspicuously display a sign, or signs, furnished by the FAA, in the main public area or areas of the airport, stating that discrimination based on race, color, or national origin is prohibited on the airport."

Figure 8.1. Summary table: federal regulatory and informational signage.

ments, except TSA security compliance signs at portals to operational or sterile areas and the security checkpoint (see Section 8.6.1).

Appendix F provides specific requirements for each message, including where or how to post the message, message content, font size and website links for additional information. These messages include:

- Passenger Rights
 - Notice of Limitation of Liability for death or injury
 - Notice of Limitation of Liability for baggage
 - Overbooking
- National Threat Advisory and TSA Signs
 - National Threat Advisory
 - TSA liquids
 - Checked Bag combo message
- Consent to Search/Passenger Identification
 - Consent to Search
 - Passenger Identification
- False Statements
- Use of X-Ray Systems
- Transportation of Hazardous Materials
- Transportation of Firearms
- Currency Reporting
- Passenger Notices
 - Public Inspection of Tariffs or Explanation of Contract Terms
 - Contract of Carriage
- Unlawful Discrimination

8.6.3 Placement of Messages

Regulatory sign placement requirements are defined by the CFR for each type of sign and provided in more details in Appendix F. Typical requirements are that the sign shall be prominently displayed so that it can be seen by passengers in locations where the aircraft operator issues tickets, checks baggage, and maintains aircraft boarding areas. General requirements for placement of each sign type are described in the following sections.

8.6.3.1 Curbside Check-In

- The TSA Liquids (revised) and the TSA Checked Baggage Combo Sign are required and typically mounted separately. Note the TSA Liquids sign is revised to meet security directive requirements, and referred to as TSA Liquids (revised).
- The remaining required messages are typically grouped together and mounted on one sign, and include:
 - Notice of Limitation of Liability for:
 - a. Death or Injury; and b. Baggage Liability
 - Notice: Overbooking of Flights
 - National Threat Advisory
 - Consent to Search/Passenger Identification
 - False Statements
 - Use of X-Ray System
 - Transportation of Hazardous Materials
 - Transportation of Firearms
 - Currency Reporting
 - Public Inspection of Tariffs

- Additional signs the airline may request curbside are listed below. It is important to coordinate all signage requirements to avoid sign clutter, and give priority to the security messages.
 - Notice of Contract/Incorporated terms
 - Checked-bag fee signs
- The required signs may be either deployed on an adjacent pillar or wall, on a separate sign holder, or mounted on the side or top of a curbside check-in podium. If not mounted on an adjacent pillar or wall, portable check-in stations are also required to mount the message on the station.

Figure 8.2 is an example of the deployment of the messages when applied to the curbside podiums. The left message measures 21" w x 24" h, which is about as small as it can get in order to deploy the message and maintain reasonable or required font sizes. The TSA messages measure 11" x 14" (required per TSA).

8.6.3.2 Ticketing/Check-In Hall

- The TSA Liquids (revised) and the TSA Checked Baggage Combo Sign are required and typically mounted separately. Note the TSA Liquids sign is revised to meet security directive requirements, and referred to as TSA Liquids (revised).

National Threat Advisory

The Secretary of the Department of Homeland Security has determined that there is a high risk of terrorism against U.S. civil aviation, and the need for extra restrictions to assure the security of air travel. Passengers are advised to travel light. Their accessible property should have minimal clutter to expedite the screening process.

- Please keep your baggage with you at all times to prevent the introduction of items without your knowledge.
- Do not accept items from unknown persons.

Please report any suspicious activity to airport police or TSA personnel.

Consent to Search / Passenger Identification

Passengers with checked baggage may be asked to present identification and/or permit inspection of their checked baggage including X-rays.

- Passengers refusing to present identification and/or permit checked baggage inspection may not be transported.
- Carry-on items and checked baggage are subject to search.

Passenger Notice

Public Inspection of Tariffs

All the currently effective passenger tariffs to which this company is a party and all passenger tariff publications which have been issued but are not yet effective are on file in this office, so far as they apply to traffic from or to any point served by this airline. These tariffs may be inspected by any person upon request and without the assignment of any reason for such inspection. The employees of this company on duty in this office will lend assistance in securing information from the tariffs.

In addition, a complete file of all tariffs of this company, with indexes thereto, is maintained and kept available for public inspection at all airline offices.

Notice of Contract/Incorporated Terms

Air transportation by your airline of choice is subject to the terms of the airline's Passenger Contract of Carriage. You may request to inspect the Contract of Carriage at the ticket counter or obtain a copy by contacting the airline.

Items included in the Passenger Contract of Carriage are restrictions, limits of liability, rules on reservations, rules regarding check-in and boarding times, rules regarding overbooking and lost tickets. For complete details and further information, contact your airline representative.

Currency Reporting

U.S. Customs and Border Protection

It is legal to transport any amount of currency or other monetary instruments into or out of the United States. However, if you transport, attempt to transport, or cause to be transported (including by mail or other means) currency or other monetary instruments in an aggregate amount exceeding \$10,000 or its foreign equivalent, at one time from the United States to any foreign country, or into the United States from any foreign country, you must file a report with U.S. Customs and Border Protection. This report is called the Report of International Transportation of Currency or Monetary Instruments (FinCEN Form 105). Furthermore, if you receive in the United States, currency or other monetary instruments in an aggregate amount exceeding \$10,000 (or its foreign equivalent) at one time, which has been transported, mailed, or shipped to you from any foreign place, you must also file a FinCEN Form 105. This form can be obtained at all U.S. ports of entry and departure or on the Web at: www.tcncc.gov/fin105_cmir.pdf.

Reporting is required under the Currency and Foreign Transaction Reporting Act (PL 97-258, 31 U.S.C. 5311, et seq.), as amended. Failure to comply can result in civil and criminal penalties and may lead to forfeiture of your monetary instruments.

Please visit the U.S. Customs and Border Protection Website at www.cbp.gov.

Transportation of Hazardous Materials

Federal law forbids the carriage of hazardous materials aboard aircraft in your luggage or on your person.

A violation can result in five years' imprisonment and penalties of \$250,000 or more (49 U.S.C. § 5104). Hazardous materials include explosives, compressed gases, flammables liquids and solids, oxidizers, poisons, corrosives and radioactive materials. Examples: paints, lighter fluid, fireworks, tear gases, oxygen bottles, and radioactive pharmaceuticals.

There are special exceptions for small quantities (up to 1/6 ounce total) of medicinal and toilet articles carried in your luggage and certain smoking materials carried in your person.

For further information contact your airline representative.

Transportation of Firearms

TSA Regulations require that firearms in checked baggage must be declared and unloaded. Passengers failing to declare firearms or transporting loaded firearms are subject to substantial civil penalties. Refer to 49 CFR Part 1544.203(f) for further details and requirements.

The transportation of unauthorized explosives or incendiary devices in checked baggage is prohibited at all times.

False Statements

Federal law prohibits any person from making false statements concerning hijacking or the carriage of weapons or explosives aboard aircraft.

X-Ray Inspection

Passengers are advised that checked baggage is being inspected by an X-ray. Passengers are advised to remove all X-ray, scientific, or high-speed film from accessible property and checked baggage before inspection. Passengers may request that an inspection be made of their photographic equipment, and film packages without exposure to an X-ray system.

Passenger Rights

Advice to Passengers on Limitations of Liability

Airline liability for death or personal injury may be limited by the Warsaw Convention and tariff provisions in the case of travel to or from a foreign country.

For most international travel (including domestic portions of international journeys), liability for loss, delay or damage to baggage is limited to approximately \$9.07 per pound for checked baggage and \$400 per passenger for unchecked baggage, unless a higher value is declared and an extra charge is paid. Special rules may apply to valuable articles.

See the notice with your tickets or consult your airline or travel agent for further information.

Notice - Overbooking of Flights

Airline flights may be overbooked, and there is a slight chance that a seat will not be available on a flight for which a person has a confirmed reservation. If the flight is overbooked, no one will be denied a seat until airline personnel first ask for volunteers willing to give up their reservation in exchange for a payment of the airline's choosing. If there are not enough volunteers the airline will deny boarding to other persons in accordance with its particular boarding priority. With few exceptions, including failure to comply with the carrier's check-in deadline (which is available upon request from the air carrier), persons denied boarding involuntarily are entitled to compensation. The complete rules for the payment of compensation and each airline's boarding priorities are available at all airport ticket counters and boarding locations.

Some airlines do not apply these consumer protections to travel from some foreign countries, although other consumer protections may be available. Check with your airline or your travel agent.

Travel Advisory

Liquids, Gels and Aerosols

OK Permitted in limited quantities:

Liquids, gels and aerosols in containers of 3 ounces (100 ml) or less.

All 3-ounce containers must fit inside one reusable quart-sized plastic bag. Please remove your plastic bag from your luggage for screening.

The 3-ounce limit does not apply to:

Formula, milk, baby food or medication

If you have any of these items, please declare them to a security officer at the screening checkpoint.

You may be subjected to secondary screening if you enter the screening checkpoint with liquids, gels, and/or aerosols on your person or in your carry-on bag.

For more information go to: www.tsa.gov

Figure 8.2. Example of TSA curbside check-in message (Source: Courtesy of SJC).

- The remaining required messages are typically grouped together and mounted on one sign, and include:
 - Notice of Limitation of Liability for:
 - a) Death or Injury; and b) Baggage Liability
 - Notice: Overbooking of Flights
 - National Threat Advisory
 - Consent to Search/Passenger Identification
 - False Statements
 - Use of X-Ray System
 - Transportation of Hazardous Materials Message
 - Transportation of Firearms
 - Currency Reporting
 - Public Inspection of Tariffs
- Additional signs the airline may request to post in the ticketing/check-in hall are their Notice of Contract/Incorporated terms (Contract of Carriage) and checked-bag fee signs. Each airline likely requires the need to post queue identity signs (first class, web check-in) at the entrance to the queue. It is important to coordinate all signage requirements to avoid sign clutter, and give priority to the queue entrance messages and the security messages within the queue.
- Traditionally, these signs are commonly displayed on top of airline ticket counters or on the front of the counter podium, turret or counter shell. Alternative locations are to place them in separate sign holders not attached to the ticket counters.
- The TSA requires placement of the liquids and checked baggage combo signs to be deployed in the ticket counter queue.
- Figure 8.3 is an example of a sign layout in a ticket queue. Two queues may share the same set of signs if located between the queues.

Figure 8.4 is an example of an in-queue panel with Federal messages and measures 24" h × 48" w.

8.6.3.3 Gate Podium

- The TSA Liquids and the TSA Checked Baggage Combo Signs are not required in the gate holdroom/gate podium area.
- The required messages are typically grouped together and mounted on one sign, and include:
 - Notice of Limitation of Liability for:
 - a) Death or Injury; and b) Baggage Liability
 - Notice: Overbooking of Flights

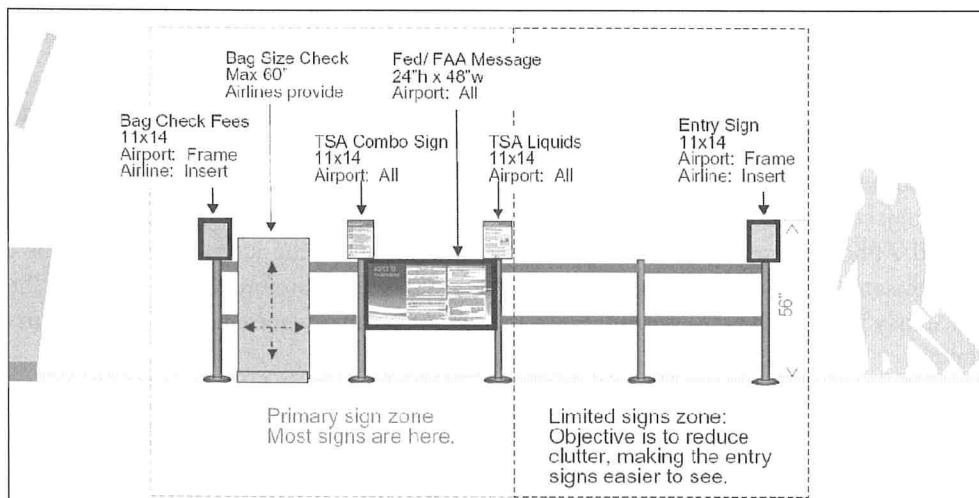


Figure 8.3. Example ticket queue (Source: Courtesy of SJC).

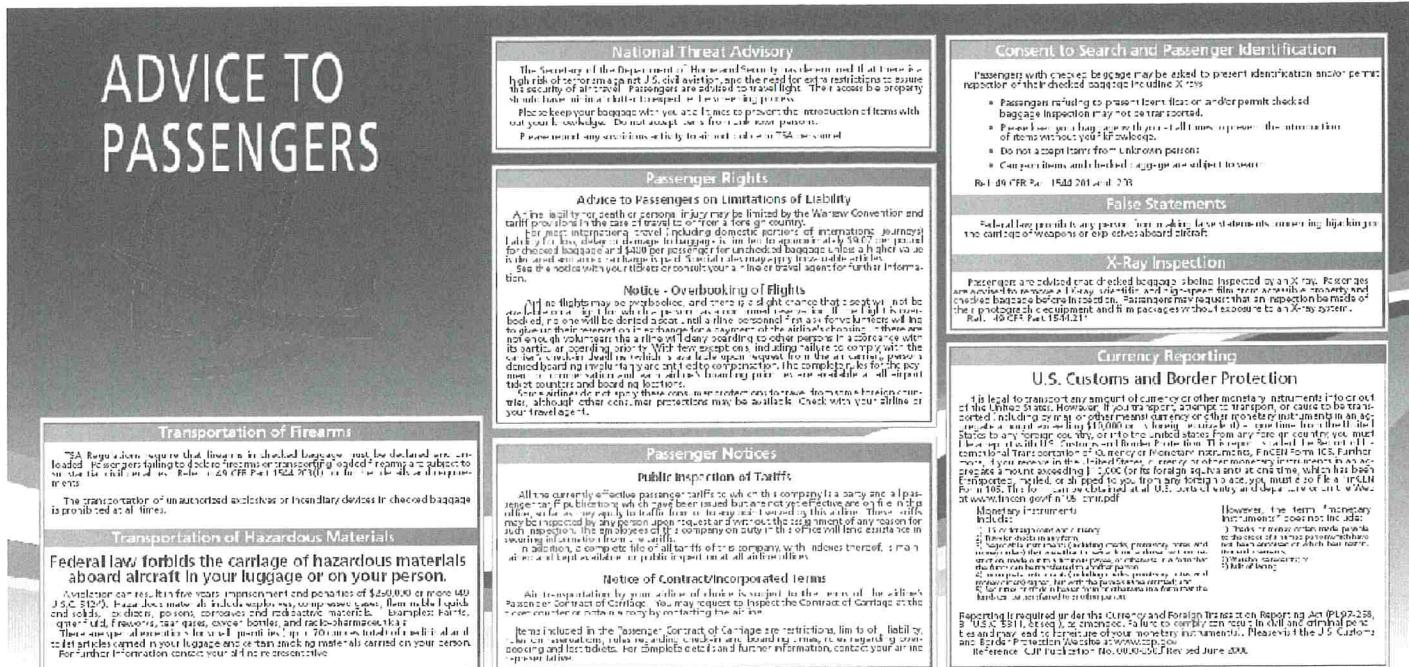


Figure 8.4. Example message panel (Source: Courtesy of SJC)

- Consent to Search/Passenger Identification
- False Statements
- Transportation of Hazardous Materials
- Public Inspection of Tariffs
- Additional signs the airline may request to post in the ticketing/check-in hall are their Notice of Contract/Incorporated terms (Contract of Carriage)
- Typically gate holdrooms are open areas consisting of the gate podium and possibly a back wall. The information typically is displayed on the gate podium. Another option is a separate sign holder, but they tend to be moved around or become a problem to maintenance personnel.
- Figure 8.5 is an example of a sign layout for the side of the podium. In order to fit all the required information on the sign and meet font requirements, the sign size became 13" w × 27" h.

8.6.3.4 Self-Service Check-In

Certain areas of the airport may have self-service check-in devices located separately from the ticketing hall or curbside check-in. The typical requirement for posting of information referenced in this document is to post where tickets are sold AND that location is under the charge of a person. The objective of the Self-Service Check-in device is to check-in for a flight that was already purchased. Although it may provide the option to pay a fee for bag check-in or to upgrade the seat, it is not the stated purpose to be used for actual selling of tickets. Therefore, the Self-Service Check-in device may be considered as not subject to the sign or posting requirements referenced in this document.

Even if consideration is given to offer users of Self-Service Check-in the option to read the messages, there may be technical challenges to display the message, at a cost that may be more than simply posting the sign. Also, use of the station to review these messages would delay others waiting in line to use the machine.

<p>Transportation of Hazardous Materials</p> <p>Federal law forbids the carriage of hazardous materials aboard aircraft in your luggage or on your person.</p> <p>A violation can result in five years' imprisonment and penalties of \$250,000 or more (49 U.S.C. 5124). Hazardous materials include explosives, compressed gases, flammable liquids and solids, oxidizers, poisons, corrosives and radioactive materials. Examples: Paints, lighter fluid, fireworks, tear gases, oxygen bottles, and radio-pharmaceuticals.</p> <p>There are special exceptions for small quantities (up to 70 ounces total) of medicinal and toilet articles carried in your luggage and certain smoking materials carried on your person.</p> <p>For further information contact your airline representative.</p>
<p>False Statements</p> <p>Federal law prohibits any person from making false statements concerning hijacking or the carriage of weapons or explosives aboard aircraft.</p>
<p>Consent to Search / Passenger Identification</p> <p>Passengers with checked baggage may be asked to present identification and/or permit inspection of their checked baggage including X-rays.</p> <ul style="list-style-type: none"> • Passengers refusing to present identification and/or permit checked baggage inspection may not be transported. • Carry-on items and checked baggage are subject to search.
<p>Passenger Rights</p> <p>Advice to Passengers on Limitations of Liability</p> <p>Airline liability for death or personal injury may be limited by the Warsaw Convention and tariff provisions in the case of travel to or from a foreign country.</p> <p>For most international travel (including domestic portions of international journeys) liability for loss, delay or damage to baggage is limited to approximately \$9.07 per pound for checked baggage and \$400 per passenger for uncheck baggage unless a higher value is declared and an extra charge is paid. Special rules may apply to valuable articles.</p> <p>See the notice with your tickets or consult your airline or travel agent for further information.</p> <p>Notice - Overbooking of Flights</p> <p>Airline flights may be overbooked, and there is a slight chance that a seat will not be available on a flight for which a person has a confirmed reservation. If the flight is overbooked, no one will be denied a seat until airline personnel first ask for volunteers willing to give up their reservation in exchange for a payment of the airline's choosing. If there are not enough volunteers the airline will deny boarding to other persons in accordance with its particular boarding priority. With few exceptions, including failure to comply with the carrier's check-in deadline (which is available upon request from the air carrier), persons denied boarding involuntarily are entitled to compensation. The complete rules for the payment of compensation and each airline's boarding priorities are available at all airport ticket counters and boarding locations.</p> <p>Some airlines do not apply these consumer protections to travel from some foreign countries, although other consumer protections may be available.</p> <p>Check with your airline or your travel agent.</p>
<p>Passenger Notices</p> <p>Public Inspection of Tariffs</p> <p>All the currently effective passenger tariffs to which this company is a party and all passenger tariff publications which have been issued but are not yet effective are on file in this office, so far as they apply to traffic from or to any point served by this airline. These tariffs may be inspected by any person upon request and without the assignment of any reason for such inspection. The employees of this company on duty in this office will lend assistance in securing information from the tariffs.</p> <p>In addition, a complete file of all tariffs of this company, with indexes thereof, is maintained and kept available for public inspection at all airline offices.</p> <p>Notice of Contract/Incorporated Terms</p> <p>Air transportation by your airline of choice is subject to the terms of the airline's Passenger Contract of Carriage. You may request to inspect the Contract of Carriage at the ticket counter or obtain a copy by contacting the airline.</p> <p>Items included in the Passenger Contract of Carriage are restrictions, limits of liability, rules on reservations, rules regarding check-in and boarding times, rules regarding overbooking and lost tickets. For complete details and further information, contact your airline representative.</p>

Figure 8.5. Example of gate podium message panel
(Source: Courtesy of SJC).

8.6.4 Method to Deploy Messages

Responsibility to deploy federally required messages is to be determined by the airport operator. Airport sign managers may choose to deploy the messages to ensure consistency with their signage programs in terms of quality and type of sign holders or graphics.

There are no known restrictions to deploy messages in electronic/dynamic form. If the intent is to cycle through the messages, the message system should be “tabbed”—the topics visible in tab format at the top of the screen, so users can see all the message titles in sequence, while each individual message is being displayed in sequence.

Deploying these messages on overhead signs or on displays above the counter is not advisable. There are likely ADA issues in regards to font size. However, a few airports have been successful at getting alternative messages posted and placed overhead, typically using abbreviated messages in order to maximize font size.



APPENDIX A

EVALUATION FORM 1a, b, c: FAQ (OBSERVATIONS OF AMBASSADORS)

TIME _____

DATE _____

LOCATION _____

*QUESTIONS ARE BASED ON INTERVIEW WITH AMBASSADORS

** SEPARATE FORM FOR EACH LOCATION THAT WILL BE OBSERVED

Question	Count
Where is baggage claim	
Where are the washrooms	
Where is the food court	
Etc	
(room for fill in Q's)	

EVALUATION FORM 2a, b, c:
FAQ (FOR STAFF AT INFORMATION DESKS TO FILL OUT)

TIME _____

DATE _____

LOCATION _____

*QUESTIONS ARE BASED ON INTERVIEW WITH STAFF AT INFORMATION DESK

**EVALUATION FORM 3a
WAYFINDING TRIALS - DRIVER
(UNFAMILIAR VISITOR)**

This questionnaire is intended for unfamiliar passengers who rely on signs and intuitive design (e.g. gates are beyond the security area) to reach their destination. If the passenger uses the airport more than once a year they should not be included in the survey.

Hi I am on contract to CURRENT Airport – indicate name badge. We are carrying out a survey to help find out where we need signs or where the current signs might confuse some passengers. Would you be willing to have me walk with you into the airport to your gate and tell me any problems you see with the signs that you see or use as we go along?

PLS PUT BOX AROUND EXAMPLE

EXAMPLE

Curbside to Check in Gate

Sign function: list check in gates for each airline

Sign location: on pillar about 15 m to right of entrance B

Concern: did not see sign at first since too far from entrance B, desired airline was not listed

Curbside to Check in Gate

PLS REPEAT FOR EACH ITEM BELOW

Sign function:

Sign location:

Concern:

To boarding pass machines

To oversize luggage

To currency exchange

Check in Gate to Security

Security to Departure Gate

To washroom

To stores

To lounges

EVALUATION FORM 4a:
WAYFINDING ASSESSMENT – ROADWAY SIGNS

Sign Type: _____
(Airline list, terminal split, parking split, etc)

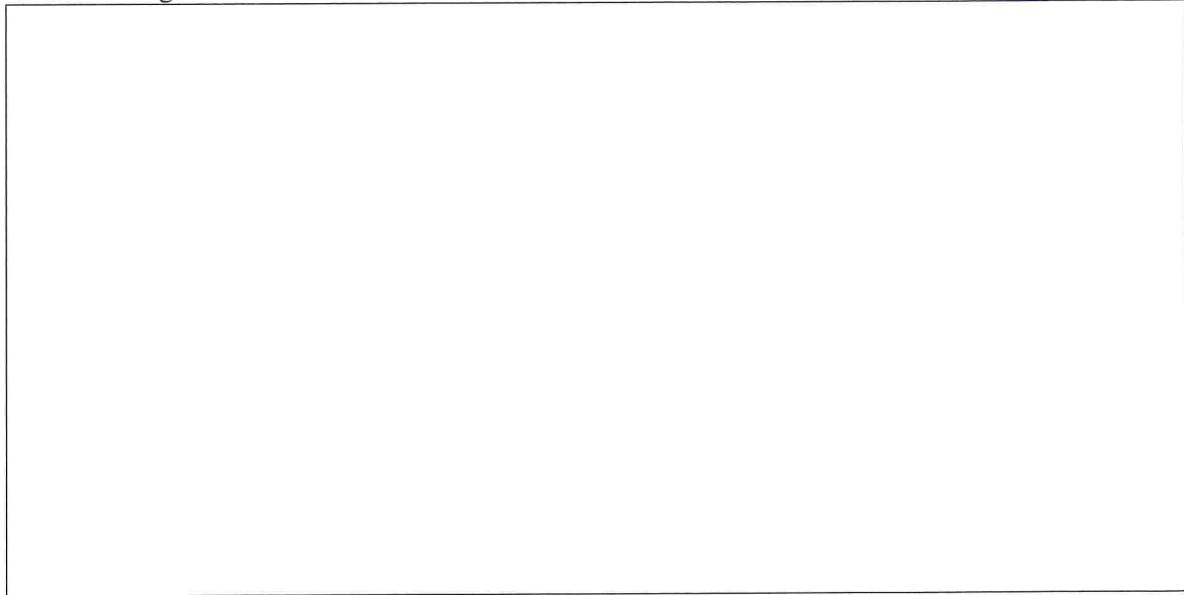
Route # _____

Sign # _____

Advance/Gore Sign
(circle one)

Sign location: _____
(Pena Blvd, terminal road, curbside, etc)

Photo of sign



(A) Estimated reading + decision time: _____ Posted speed: _____
(based on prior airport research)

(B) Time from sign legible to sign: _____ (C) Time from sign to gore: _____

(D) Maximum potential lane change time _____
(10, 17, 24 sec)

Is B-A < 0 _____

Is A + D < B - C _____

Conspicuousness / location Good / OK / Poor
(circle one)

Comprehension Good / OK / Poor

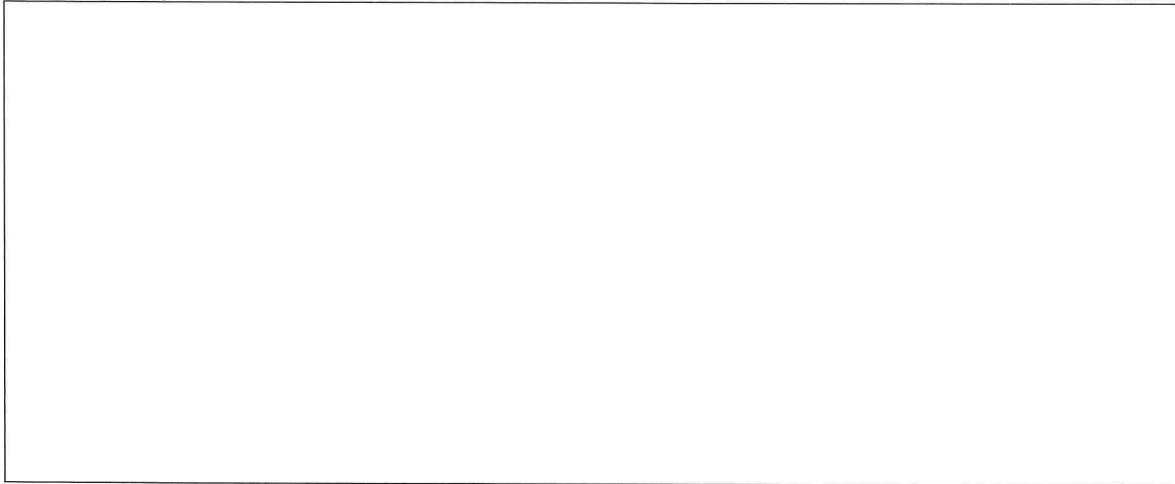
EVALUATION FORM 4b:
WAYFINDING ASSESSMENT – PEDESTRIAN SIGNS

Sign Type: _____

Sign #: _____

Sign location: _____

Photo of sign



Conspicuousness:

(colour, lighting, contrast)

Location relative to path: _____

Legibility from desired distance: _____
(record desired distance)

Comprehension: _____

Consistency: _____
(colour/layout, terminology, location)

Information Load: _____

For map signs only _____ (Orientation, clarity of
graphics, simplicity of graphics, appropriate information)



APPENDIX B

Parking—Basic Mounting Types

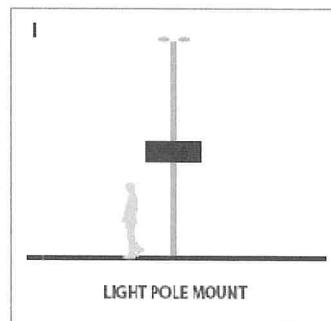
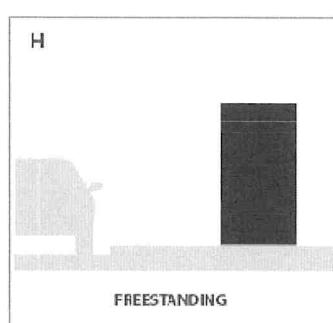
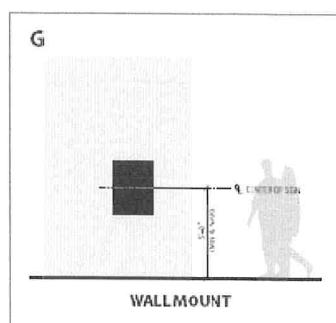
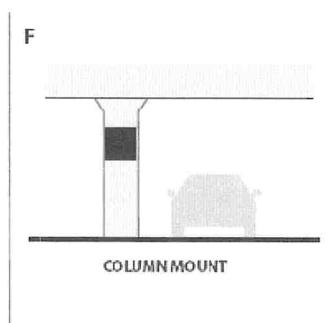
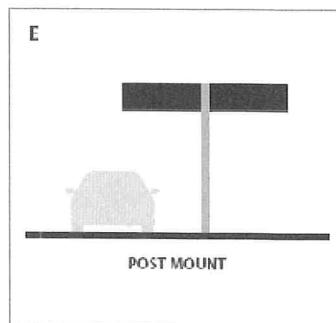
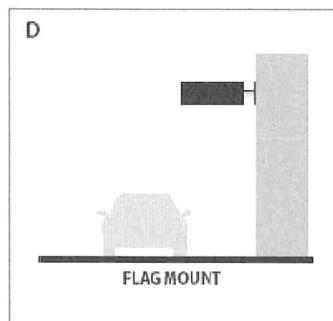
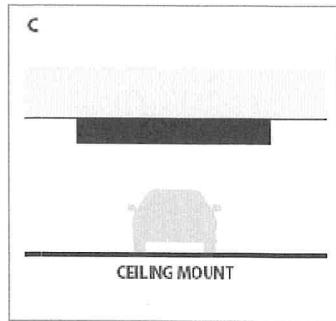
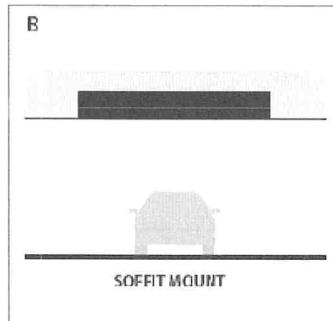
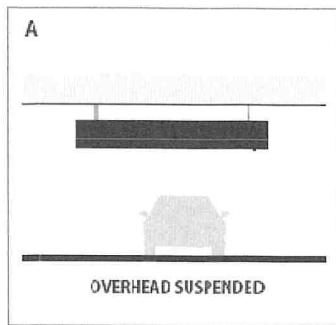
The basic mounting types used within parking areas are overhead suspended, soffit mount, ceiling mount, flag mount, wall mount, post mount, and floor mount.

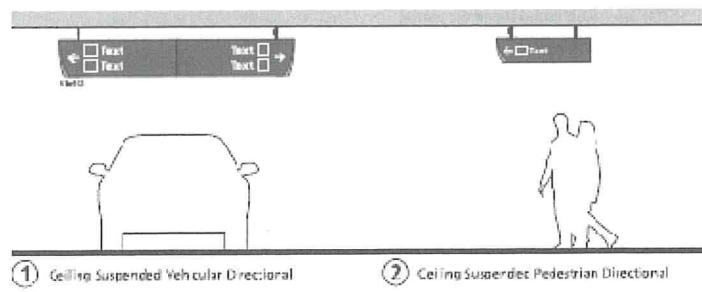
The following lists the types of general sign mounting that will be found throughout the parking areas:

- A. Overhead Suspended**—Signs that are suspended from the ceiling using a cable or break-away fastening system
- B. Soffit Mount**—Signs that are located on an architectural soffit or wall, and mounted with the back of the sign to the soffit or wall using a mechanical fastening system
- C. Ceiling Mount**—Signs that are located flush to the ceiling and mounted with the top of the sign to the ceiling using a mechanical fastening system
- D. Flag Mount**—Signs that are mounted perpendicular to the attachment surface, usually on a column, wall and / or soffit, and attached using a mechanical fastening system
- E. Post Mount**—Signs that are mounted directly to a ground mounted single or double post structure using a mechanical fastening system
- F. Column Mount**—Signs that are mounted with the back of the sign to the column using a mechanical fastening system
- G. Wall Mount**—Signs that are mounted with the back of the sign to the wall using a mechanical fastening system
- H. Freestanding**—Signs that have their bases mounted directly to the ground/finished floor using a mechanical fastening system
- I. Light Pole Mount**—Signs that are mounted directly on the existing light pole structures

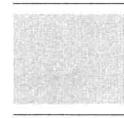
Mounting Restrictions

Minimum clearance heights for overhead vehicular signs are dictated by architectural design limitations and must be coordinated with posted clearance at the entrance to the parking structure.





The sign system concept for parking at SJC illustrates how the pedestrian directional (2) sign is subordinate to the vehicular directional (1) sign in size, scale and location.



APPENDIX C

Curbside—Basic Mounting Types

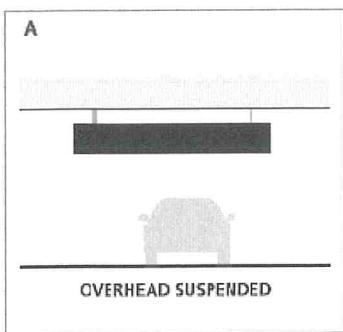
The basic mounting types used within curbside/ground transportation areas are overhead suspended, ceiling mount, flag mount, wall mount, post mount, and floor mount.

The following lists the types of general sign mounting that will be found throughout the curbside areas:

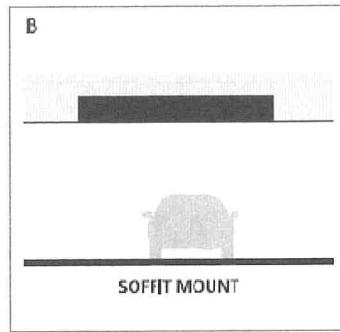
- A. Overhead Suspended**—Signs that are suspended from the ceiling using a cable or break-away fastening system
- B. Soffit Mount**—Signs that are located on an architectural soffit or wall, and mounted with the back of the sign to the soffit or wall using a mechanical fastening system
- C. Canopy Mount**—Signs that are either suspended or flush to the canopy and mounted with the top of the sign to the canopy using a mechanical fastening system
- D. Flag Mount**—Signs that are mounted perpendicular to the attachment surface, usually on a wall and/or soffit, and attached using a mechanical fastening system
- E. Post Mount**—Signs that are mounted directly to a ground mounted single or double post structure using a mechanical fastening system
- F. Freestanding**—Signs that have their bases mounted directly to the ground/finished floor using a mechanical fastening system

Mounting Restrictions

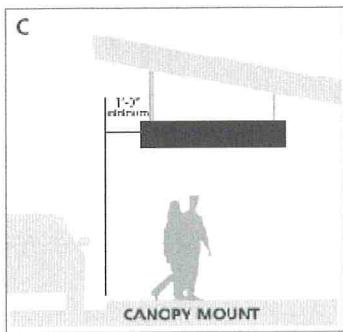
Minimum clearance heights for overhead vehicular signs are dictated by overall architectural limitations and must be coordinated with posted clearance information provided in advance of the curbside.



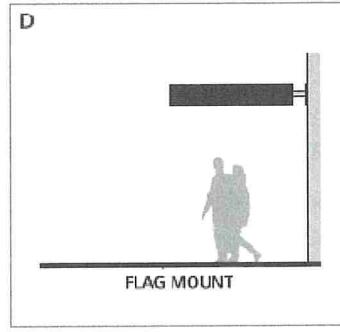
Shall be mounted perpendicular to vehicular traffic flow



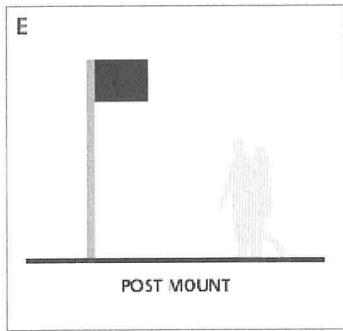
Shall be mounted perpendicular to vehicular traffic flow



Shall be mounted perpendicular to vehicular traffic flow

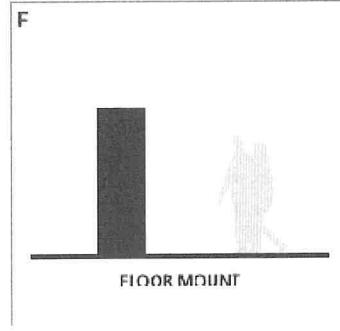


Shall be mounted perpendicular to pedestrian traffic flow



Shall be mounted perpendicular to pedestrian traffic flow

Must be mounted so that the base can break away in case of an accidental vehicular collision



Shall be mounted perpendicular to pedestrian traffic flow for directional applications



APPENDIX D

Terminals—Basic Mounting Types

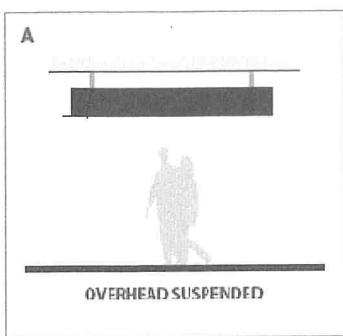
The basic mounting types used within Terminal and Concourse areas are overhead suspended, soffit mount, ceiling mount, flag mount, wall mount, post mount, and freestanding.

The following lists the types of general sign mounting that will be found throughout the concourse areas:

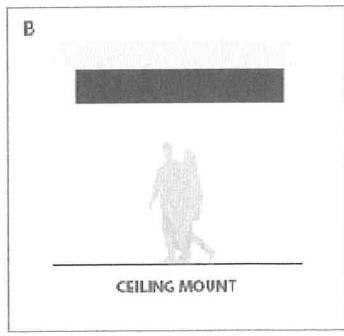
- A. Overhead Suspended**—Signs that are suspended from the ceiling using a cable or break-away fastening system
- B. Ceiling Mount**—Signs that are located flush to the ceiling and mounted with the top of the sign to the ceiling using a mechanical fastening system
- C. Soffit Mount**—Signs that are located on an architectural soffit or wall, and mounted with the back of the sign to the soffit or wall using a mechanical fastening system
- D. Flag Mount**—Signs that are mounted perpendicular to the attachment surface, usually on a wall and/or soffit, and attached using a mechanical fastening system
- E. Post Mount**—Signs that are mounted directly to a ground mounted single or double post structure using a mechanical fastening system
- F. Wall Mount**—Signs that are mounted with the back of the sign to the wall using a mechanical fastening system
- G. Freestanding**—Signs that have their bases mounted directly to the ground/finished floor using a mechanical fastening system

Mounting Restrictions

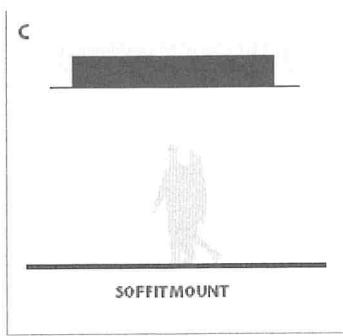
Per ADA all overhead pedestrian signs shall be mounted at a minimum of 6'-8" above finished floor to the bottom of the sign. Preferred mounting height should maintain a consistent height that ranges between 8'-6" and 10'-0" above finished floor to the bottom of the sign.



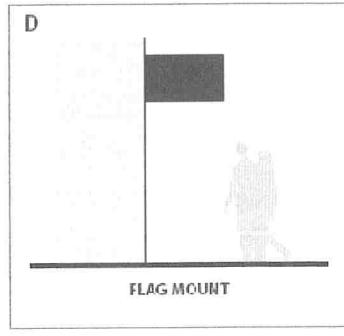
Shall be mounted perpendicular to pedestrian traffic flow



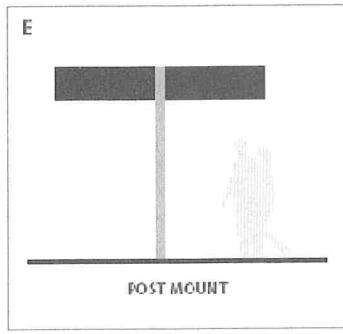
Shall be mounted perpendicular to pedestrian traffic flow



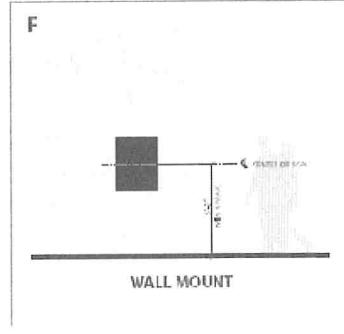
Shall be mounted perpendicular to pedestrian traffic flow



Shall be mounted perpendicular to pedestrian traffic flow

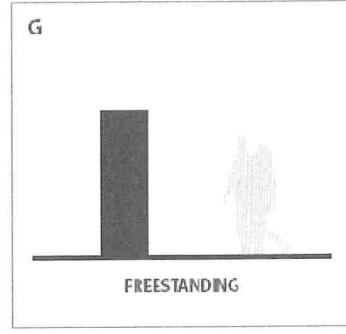


Shall be mounted perpendicular to pedestrian traffic flow



Will be located at a minimum and no more than a maximum of 5'-0" to the center of the sign

Shall not project more than 4" from the face of the wall



Shall be mounted perpendicular to pedestrian traffic flow

Roadway Signing—Additional Resources

The United States Department of Transportation Federal Aviation Administration (FAA) has addressed roadway signing in two Advisory Circulars. “Standards for Airport Sign Systems”⁴⁸ states:

Roadway Signs. These are signs located on the airfield that are solely intended for vehicle operators. They should conform to the categorical color codes established by the Manual on Uniform Traffic Control Devices (MUTCD).

While this document refers to service vehicles operating on and around the runways and taxiways, it is important to note that even the FAA acknowledges the MUTCD as the ruling document.

In addition, FAA Advisory Circular Number 150/5360-12E, dated 9/18/08, “Airport Signing and Graphics”⁴⁹ makes recommendations regarding airport signing and graphics.

This Advisory Circular essentially simply refers users to the 2001 Guideline. For international airports, the Circular advises users to consult the International Civil Aviation Organization (ICAO) Document 9636, “International Signs to Provide Guidance to Persons at Airports and Marine Terminals (1995)”⁵⁰. Most importantly for roadway signing, the FAA Advisory Circular recommends:

The preparation and location of signing for terminal related roadways and other thoroughfares should comply with the Federal Highway Administration’s “Manual on Uniform Traffic Control Devices for Streets and Highways.”

The American Association of State and Highway Officials (AASHTO) also publishes a 3-part series document that is intended to assist state agencies in determining how to best sign state highways for airport facilities. These documents are:

- Guide Signs, Part I: Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Freeways, 4th Edition
- Guide Signs, Part II: Guidelines for Airport Guide Signing
- Guide Signs, Part III: List of Control Cities for Use in Guide Signs on Interstate Highways

Part I of this revised document provides a basis for development of state policies for selection of supplemental guide signs for traffic generators adjacent to freeways, including airports. Part II, on airport guidelines specifically, has been expanded to include all highways. Part III contains the list of approved control cities for purposes of providing directional guidance on the Interstate Highway System⁵¹. This list of cities is to be used for trailblazing purposes on all signs and represents major destinations along the interstate system.

In order for airport roadway wayfinding to comply with the MUTCD there is a list of wayfinding challenges for airport users that need to be considered.

- Understanding roadway decision points
- Airport terminology
- Message hierarchies and lines of text
- Regulatory and warning signs
- Sign spacing and design speeds
- Sign size, font, and colors
- Use of symbols and arrows
- Changeable message signs



APPENDIX F

This appendix provides specific requirements for the following federal regulatory and informational signage requirements:

Passenger Rights

Notice of Limitation of Liability for death or injury

Notice of Limitation of Liability for baggage

Overbooking

National Threat Advisory and TSA Signs

National Threat Advisory

TSA liquids

Checked Bag combo message

Consent to Search/Passenger Identification

Consent to Search

Passenger Identification

False Statements

Use of X-Ray Systems

Transportation of Hazardous Materials

Transportation of Firearms

Currency Reporting

Passenger Notices

Public Inspection of Tariffs or Explanation of Contract Terms

Contract of Carriage

Unlawful Discrimination

Passenger Rights

Message: Various Passenger Rights Messages

- o Liability, death or injury
- o Liability for Baggage
- o Overbooking

Required by: Refer to each item and specific requirement

- o 14 CFR 221.105 (Liability, death or injury)
- o 14 CFR 221.106 (Liability for Baggage)
- o 14 CFR 250.11 (Overbooking)

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.

- 1) Go to: <http://ecfr.gpoaccess.gov>
- 2) Select Title 14
- 3) Select the appropriate link to the section you want. For example, select Section 221, then select part 105 from the next page of links.

Font/ Size: 14 CFR221.105: bold faced type at least one-fourth of an inch high
 14 CFR221.106: Legible English, bold-face, at least .635 cm (0.25 in) in height.
 14 CFR250.11: Legible English, bold face, at least .635 cm (0.25 inch) in height.

Location: These signs are most commonly displayed on top of airline ticket counters or on the front of the counter podium, turret or counter shell.

Note: These notices are generally combined into one sign and located so as to be clearly readable by the traveling public.

Variable Yes, the coverage mentioned in the liability is subject to change.

14 CFR 221.105 describes a sign to be posted with a message regarding *Advice to International Passengers on Limitation of Liability*. Travelers may depart on a domestic flight from a terminal that does not have international flights, but still connect to an international flight. This message apparently is intended for them. Section (b) describes the message of the sign, that it is

- **To be displayed continuously in a conspicuous public place** at each desk, station, and position in the United States which is in the charge of a person employed exclusively by it or by it jointly with another person, or by any agent employed by such air carrier or foreign air carrier to sell tickets to passengers
- That it shall be printed in **bold faced type at least one-fourth of an inch high**.

Later, in Part 106, an option is given to take the Part 105 message and the Part 106 message for a combined, single message. See below for details regarding content.

14 CFR 221.106 describes a sign for *Notice of limited liability for baggage*. It later indicates the option of a consolidated notice of liability limitations, to "...use the following notice in full compliance with the posting requirements of this paragraph and of §221.105(b)" with the notice given as shown below. The same requirements – **displayed in a conspicuous public place, and be printed in bold faced type at least one-fourth of an inch high** is still required. The message:

Advice to Passengers on Limitations of Liability

Airline liability for death or personal injury may be limited by the Warsaw Convention and tariff provisions in the case of travel to or from a foreign country.

For most international travel (including domestic portions of international journeys) liability for loss, delay or damage to baggage is limited to approximately \$9.07 per pound for checked baggage and \$400 per passenger for unchecked baggage unless a higher value is declared and an extra charge is paid. Special rules may apply to valuable articles.

See the notice with your tickets or consult your airline or travel agent for further information.

14 CFR 221.106 Part 106(a)(3) provides the option of including the terms of \$ per kilo (i.e., \$20.00 per kilo). This is not a requirement, but could be considered.

Based on the language in the regulations, and the possible wide variety of air carriers, the message stated above likely meets all air carrier requirements. If liability changes (\$9.07 per pound for checked baggage and \$400 per passenger), it is likely that sign patches may be necessary to avoid a complete sign replacement. Sign Managers must annually check the eCFR for updates.

14 CFR 250.11, the "Overbooking message", has these specific requirements:

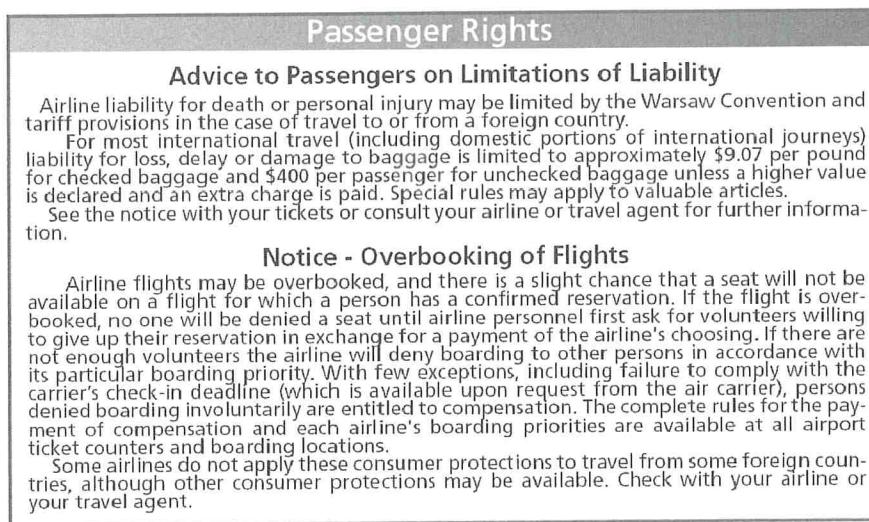
- Every carrier shall cause to be **displayed continuously in a conspicuous public place** at each desk, station, and position in the United States which is in the charge of a person employed exclusively by it, or by it jointly with another person, or by any agent employed by such air carrier or foreign air carrier to sell tickets to passengers, a sign located so as to be clearly visible and clearly readable to the traveling public,...
- ... which shall have printed thereon the following statement in **boldface type at least one-fourth of an inch high** – see statement below
- There is a mid-statement requirement to choose one of two options.
 - With few exceptions, including failure to comply with the carrier's check-in deadline (carrier shall insert either "of _ minutes prior to each flight segment" or "(which are available upon request from the air carrier)" here)
 - Recommendation is to include the statement "(which are available upon request from the air carrier)". Note that the grammar in the requirement appears to be in error... that one should use "...is available" and not "...are available".
- Actual statement with changes as recommended above:

Notice—Overbooking of Flights

Airline flights may be overbooked, and there is a slight chance that a seat will not be available on a flight for which a person has a confirmed reservation. If the flight is overbooked, no one will be denied a seat until airline personnel first ask for volunteers willing to give up their reservation in exchange for compensation of the airline's choosing. If there are not enough volunteers, the airline will deny boarding to other persons in accordance with its particular boarding priority. With few exceptions, including failure to comply with the carrier's check-in deadline (which is available upon request from the air carrier), persons denied boarding involuntarily are entitled to compensation. The complete rules for the payment of compensation and each airline's boarding priorities are available at all airport ticket counters and boarding locations.

Some airlines do not apply these consumer protections to travel from some foreign countries, although other consumer protections may be available. Check with your airline or your travel agent.

An example of the Passenger Rights sign that addresses Advice to Passengers on Limitations of Liability and the Notice –Overbooking of Flights is below:



National Threat Advisory and TSA Signs

Message: National Threat Advisory
TSA Liquids (revised)
Checked Bag Combo

Required by: Refer to each item and specific requirement

- o TSA Airport Signage Guidelines dtd August 2008 (TSA Checked Bag Combo). There is no known authority for these guidelines other than the TSA states they are required.
- o Security directive at time of writing: Security Directive 1544-06-01D

Web Link: No known links

Font/ Size: Varies

- o TSA Liquids (revised) and Checked Bag Combo follow the sign format (size, varying font sizes, type of font) developed by the TSA.
- o National Threat Advisory text size not specified. Following text size for passenger rights, typically use 0.25 inch font height.

Location: Curbside Check-in, Ticketing/Check-in Hall
NOTE: Liquids message is often found in the security queue as well.

Variable No rates or fines are given. Likely to change due to periodic TSA updates to TSA signage guidelines or TSA issues new security directives.

TSA Checked Bag Combo: According to the TSA Airport Signage Guidelines dated August 2008:

- The Checked Baggage Combo sign is required for each checked baggage area, as a part of the complete Checkpoint Evolution package. The sign is legally required (the TSA signage guidelines do not state the legal basis for the requirement).
- Size of Checked Baggage Combo – 22"x28" or 11"x14"
- Requirement: Required by TSA; no
- Location: Front and back of one stanchion, **placed within the air carrier queue** or at the entrance to the ETD/EDS node. EDS is Explosives Detection Systems and EDT is Explosives Trace Detection.
- TSA has required the TSA Checked Bag Combo message at curbside check-in, though the requirement for double-sided sign did not necessarily apply since stanchions may not be used outside due to weather or safety concerns. Instead, the sign may be mounted on the surface of the podium or on the adjacent wall or column.

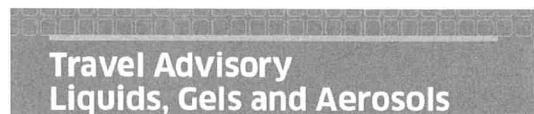
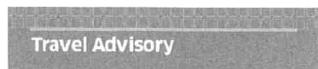
TSA Liquids and National Threat Advisory: Security Directive 1544-06-01D (current as of the time of this writing), has four (4) advisories that the air carriers are required to provide to its passengers. Those advisories are:

1. Advise passengers that they are prohibited from taking liquids, gels, and/or aerosols through the passenger screening checkpoint into the sterile area EXCEPT one clear resealable 1 quart (1 liter) size plastic bag containing liquids, gels, and/or aerosols in travel size containers (3.4 oz./100 ml) capacity or less per container. The contents of the plastic bag must fit comfortably and the plastic bag must be completely closed/sealed and subjected to x-ray inspection separate from passengers' carry-on bag.
2. Advise passengers that they may have the following items, but must declare them to TSA at the screening checkpoint if not contained in a clear transparent resealable 1 quart (1 liter) size plastic bag and/or the size of the containers exceed travel size (3.4 oz./100 ml).
 - a. Baby formula/milk (to include breast milk) and baby food/juice in containers if a baby or small child is traveling.
 - b. Medications (liquid, gel, and aerosol).
 - c. Liquids (to include juice) or gels or diabetic or other medical needs.
3. Advise passengers that they may be subjected to secondary screening if they enter the screening checkpoint with liquids, gels, and/or aerosols on their person or in their carry-on bag.
4. Advise passengers that the Secretary of the Department of Homeland Security has determined that there is a high risk of terrorism against U.S. civil aviation, and the need for extra restrictions to assure the security of air travel. Advise passengers to travel light. Their accessible property should have minimal clutter to expedite the screening process.

SJC evaluated the liquids message as an option to meet the security directive. TSA regulatory personnel stated the TSA Liquids Combo message was insufficient to meet the security directives requirement. SJC was also informed that the security directive language did not have to be repeated verbatim, but could be shortened as long as the intent of the message is included.

Instead of developing a second message, SJC added information to the TSA Liquids Combo message. The two messages are compared below:

- The left message is the original TSA Liquids message
- The right message, TSA Liquids (revised), was developed by SJC, meets TSA security directive for points 1 to 3 above, and was approved for deployment by TSA regulatory personnel.

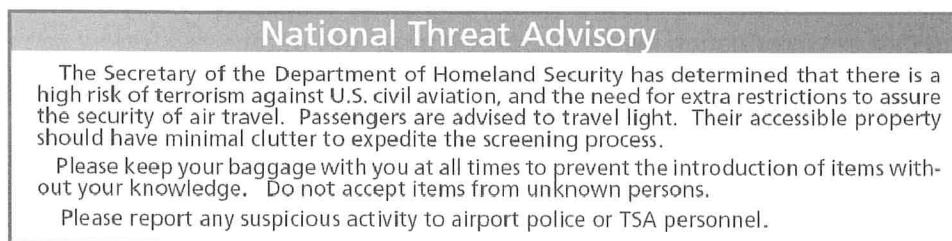


The last requirement of the Security Directive (threat advisory, travel light, and avoid clutter) can be achieved by making a separate sign or including the information with the other advisory signs given to passengers. The sign title National Threat Advisory is recommended to draw attention to the issues stated in the Security Directive.

In addition, the requirements may also be combined with the traditional information (i.e., as noted in current AAAE/ACI signage guidelines) given to passengers. There is no known requirement for these additional points, yet they may be implied by various air carrier or airport security directives. This information includes:

- Keep baggage with you at all times
- Do not accept items from unknown persons
- Please report suspicious activity to airport police or TSA personnel.

An example of the National Threat Advisory message is displayed below:



Consent to Search / Passenger Identification

Messages: Consent to Search (including checked baggage)
Passenger Identification

Required by: Aircraft operators or Airport Security Program; referenced as follows:
o Title 49 C.F.R., 1540.107 Submission to screening and inspection.

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.
1) Go to: <http://ecfr.gpoaccess.gov>
2) Select Title 49
3) Select the appropriate links to the section you want. For example, select Section 1540 and then select part 107 from the next page of links.

Font/ Size: Text size not specified. Recommend using consistent font as in other messages to passengers such as passenger rights, so use 0.25 inch font height.

Location: Curbside Check-in, Ticketing/Check-in Hall, Gate Podium

Fine Amount: N/A

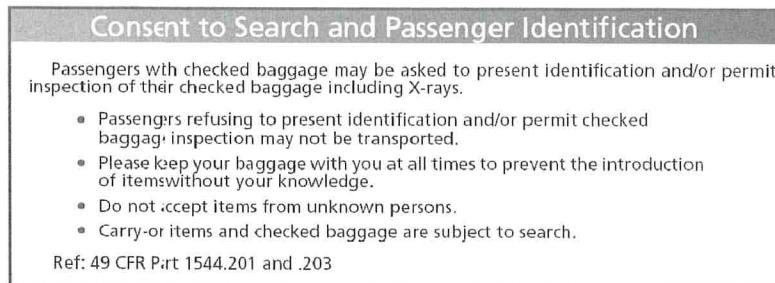
49 CFR 1540.107 describes submission to screening and inspection. It essentially gives these definitions of what is to be submitted:

- (a) No individual may enter a sterile area or board an aircraft without submitting to the screening and inspection of his or her person and accessible property in accordance with the procedures being applied to control access to that area or aircraft under this subchapter.
- (b) An individual must provide his or her full name,
- (c) An individual may not enter a sterile area or board an aircraft if the individual does not present a verifying identity document

Air carrier or airport security plans may require that individuals be informed they will be screened and be asked to provide identification. However, there is no specific sign requirement or information on where such information should be posted. It is assumed that the information ideally should be given out upon check-in (ticket hall and curbside). It is also possible that secondary searches may occur at the gate before boarding an aircraft, so the message should be posted there as well. The message may be included with other passenger advisory messages (i.e., on a single sign panel).

Without any specific sign requirement, the proposed language may be based on the AAAE/ACI signage guidelines. The suggested language to the right was accepted at SJC by TSA regulatory personnel:

Example sign:



False Statements

Message: False Statement

Required by: Aircraft operators or Airport Security Program; referenced as follows:
o 49USC Sec. 46507. False information and threats

Web Link: The electronic United States Code is the preferred website for investigating further these requirements.

- 1) Go to: <http://www.gpoaccess.gov/USCODE/index.html>
- 2) In the browse box, enter 49 USC 46507
- 3) Select the appropriate links to the document you want

Font/ Size: Text size not specified. Recommend using consistent font as in other messages to passengers such as passenger rights, so use 0.25 inch font height.

Location: Curbside Check-in, Ticketing/Check-in Hall, Gate Podium

Fine Amount: N/A

Title 49 U.S.C. § 46507(1) makes it a crime to willfully and maliciously, or with reckless disregard for safety, convey false information, knowing such information to be false, concerning an attempt to do an act which would be a felony prohibited by various sections of Title 49.

There is no known requirement to post a sign regarding false statements. There is no known specific text to use as well. Yet the need for the message is obvious. The proposed language shown below is a “traditional statement” as noted in past airport signage guidelines. The message may be included with other passenger advisory messages (i.e., on a single sign panel).

One example is shown below:



Use of X-Ray Systems

Message: X-Ray Inspection

Required by: 49 CFR Part 1544.211

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.

- 1) Go to: <http://ecfr.gpoaccess.gov>
- 2) Select Title 49
- 3) Select the appropriate links to the section you want. For example, select Section 1544 and then select part 211 from the next page of links

Font/ Size: Text size not specified. Recommend using consistent font as in other messages to passengers such as passenger rights, so use 0.25 inch font height.

Location: Curbside Check-in, Ticketing/Check-in Hall (in security checkpoint queue, the TSA Airport Signage Guidelines include the required Film Advisory message)

Fine Amount: N/A

49 CFR Part 1544.211 (e) requires a sign to be posted in a **(1) conspicuous place at the screening checkpoint and (2) where the aircraft operator accepts checked baggage**. Therefore, this sign is required in the ticketing hall and curbside check-in. At the security checkpoint, the TSA has responsibility for signage for the X-ray equipment, and post a simplified message in their Film Advisory message (though technically not complying with the law, the simplified message works) .

49 CFR Part 1544.211 (e) (3) requires that the sign does the following:

- **Must notify individuals that such items are being inspected by an X-ray and advise them to remove all X-ray, scientific, and high-speed film from accessible property and checked baggage before inspection.**
- **This sign must also advise individuals that they may request that an inspection be made of their photographic equipment and film packages without exposure to an X-ray system.**
- If the X-ray system exposes any accessible property or checked baggage to more than one milliroentgen during the inspection, the sign must advise individuals to remove film of all kinds from their articles before inspection.

The example below complies with the requirements of the sign. The message is typically included with other advisory messages given to the passengers.



Transportation of Hazardous Materials

Message: Transportation of Hazardous Materials

Required by: 49 CFR 175.25

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.

- 1) Go to: <http://ecfr.gpoaccess.gov>
- 2) Select Title 49
- 3) Select the appropriate links to the section you want. For example, select Section 175 and then select part 25 from the next page of links

Font/ Size: Legible English, lettering at least 1 cm (0.4 inch) in height in the first sentence and 4 mm (0.16 inch) in height for the remaining sentences.

Location: Required to be posted at all curbside check-in points, airline ticket counters, passenger boarding areas and air cargo facilities. Each notice must be legible and prominently displayed so that it may be seen by passengers or shippers. In cases where air carriers share curbside check-in, a ticket counter, or boarding area, it is not necessary for each airline to post a sign as long as the sign can be read by all passengers in the respective areas.

Note: A similar, yet slightly different message is required to be posted at air cargo facilities. Refer to Federal Hazardous Materials Regulations 49 CFR parts 171 through 180 for this revised message content.

Fine Amount: Periodically check 49 CFR 175.25 for updates to the fines.

49 CFR 175.25 requires notification – a display - at air passenger facilities of hazardous materials restrictions. Specific requirements are:

- Be legible
- Be prominently displayed so that it can be seen by passengers in locations where the aircraft operator issues tickets, checks baggage, and maintains aircraft boarding areas.
- Must be printed in legible English with lettering at least 1 cm (0.4 inch) in height in the first sentence and 4 mm (0.16 inch) in height for the remaining sentences.

Each notice must communicate the following information:

First Sentence: Federal law forbids the carriage of hazardous materials aboard aircraft in your luggage or on your person.

Remaining Sentences: Federal law forbids the carriage of hazardous materials aboard aircraft in your luggage or on your person. A violation can result in five years' imprisonment and penalties of \$250,000 or more (49 U.S.C. 5124). Hazardous materials include explosives, compressed

gases, flammable liquids and solids, oxidizers, poisons, corrosives and radioactive materials. Examples: Paints, lighter fluid, fireworks, tear gases, oxygen bottles, and radio-pharmaceuticals.

There are special exceptions for small quantities (up to 70 ounces total) of medicinal and toilet articles carried in your luggage and certain smoking materials carried on your person. For further information contact your airline representative.

Since this message includes a statement regarding fines, the airport sign manager must annually check for updates to the fines as posted in 49 CFR 175.25. Though the language references US Code: 49 U.S.C. 5124 (Criminal penalty), this section of the Code only states that the person would be fined under Title 18 (of the US Code).

An example of a message is presented below:



Transportation of Firearms

Message: Transportation of Firearms

Required by: Required by TSA or aircraft operators security program; referenced as follows:

- o 49 CFR 1544.203(f)

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.

- 1) Go to: <http://ecfr.gpoaccess.gov>
- 2) Select Title 49
- 3) Select the appropriate links to the section you want. For example, select Section 1544 and then select part 203 from the next page of links

Font/ Size: Text size not specified. Recommend using consistent font as in other messages to passengers such as Passenger Rights message, so use 0.25 inch font height.

Location: Curbside Check-in, Ticketing/Check-in Hall, Gate Podium

Fine Amount: N/A

49 CFR 1544.203(f) makes it clear that:

- The aircraft operator must ensure that all checked baggage is inspected for explosives and incendiaries before loading it on its aircraft, in accordance with §1544.207.
- No aircraft operator may knowingly permit any person to transport in checked baggage loaded firearms, or unloaded firearms that do not meet specific conditions.
- It also states that each aircraft operator must use the procedures in its security program to control checked baggage that it accepts for transport on an aircraft.

A logical conclusion is that a sign must be posted to explain the requirements. Since the regulations refer to aircraft operators, the actual requirement is likely in the aircraft operator's security plan, which the TSA has to approve. However, there is no known specific requirement.

The suggested language below was reviewed and approved by the TSA regulatory personnel. It was also approved to be posted with other passenger notices on a single panel sign.

Transportation of Firearms

TSA Regulations require that firearms in checked baggage must be declared and unloaded. Passengers failing to declare firearms or transporting loaded firearms are subject to substantial civil penalties. Refer to 49 CFR Part 1544.203(f) for further details and requirements.

The transportation of unauthorized explosives or incendiary devices in checked baggage is prohibited at all times.

Currency Reporting

Message: Currency Reporting (formerly Transportation of Large Amounts of Currency)

Required by: There is no known requirement to post this sign.
For information regarding possible signage, refer to CBP Publication No. 0000-0503 Revised June 2006 (web link below)

Web Link: The web link to the Currency Reporting poster:

- 1) Go to: <http://www.cbp.gov>
- 2) Select Newsroom – Publication – Travel Publication
- 3) Select Currency Reporting Flyer

Font/ Size: Not specified. Due to size of message, main message should match similar font size as given in Passenger Rights (0.25 in), and secondary lists as 0.16 in.

Location: Traditionally, at ticket counters including curbside check-in podiums.

Fines: Periodically check CBP publication for Currency Reporting

Note: None

There is no known requirement to post this information. Airlines may be required to provide this information. Message content has been defined by Customs and Border Protection (CBP) Publication No. 0000-0503. See Web-Direct above for a link to the publication and the specific language.

The recommended location for the message is with other passenger notices on a single panel sign. Here is the proposed content of the message that must match the language in the CBP publication:



Passenger Notices

Messages: Public Inspection of Tariffs or Explanation of Contract Terms
Contract of Carriage

Required by: 14 CFR 221.103 Notice of tariff terms
OR
14 CFR 221.107 Notice of contract terms
(Contract of Carriage is discussed in this section but is not a requirement)

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.
1) Go to: <http://ecfr.gpoaccess.gov>
2) Select Title 14
3) Select the appropriate links to the section you want. For example, select Section 221 and then select part 103 from the next page of links

Font "Printed in large type". Suggested font size is similar to the Passenger Rights messages, which require font size of 0.25 in

Location: Curbside check-in; Ticketing/check-in hall

Fine Amount: N/A

14 CFR 221.100 requires that the public be notified of tariff information. Tariff by definition in 14 CFR 221 refers to fares applied to an airline ticket. Carriers must make tariff information available to the general public, and in so doing must comply with either:

- (a) Sections 221.101, 221.102, 221.103, 221.104, 221.105, and 221.106, OR
- (b) Sections 221.105, 221.106 and 221.107 of this subpart.

Sections 221.105 and 221.106 are already addressed in Advice to Passengers on Limitations of Liability (see Exhibit 2). 14 CFR 221.103 and 14 CFR 221.107 both require a sign to be displayed, but only one of them is actually required according to 14 CFR 221.100. About these two sections:

- 14 CFR 221.103 is Public Inspection of Tariffs and traditionally posted at airports alongside the messages regarding Advice to Passengers on Limitations of Liability (see Exhibit 2)
- 14 CFR 221.107 is Explanation of Contract Terms, and is somewhat similar to the statement in Public Inspection of Tariffs.
- The regulations do not explain which to use. Yet in both cases, the information must be displayed in a **conspicuous public place** and be **printed in large type**.

The two sign types (not including airline contract of carriage) are displayed below. For the sections of the sign which indicate an "insertion" of a specific destination or address, the following recommendations are provided:

- For: *(Here name the point.)*, instead provide this message "...so far as they apply to traffic from or to any point served by this airline."
- For: *(Here indicate the place or places where tariff files are maintained...)*, instead provide this message "...at all airline offices."

One the insertions are applied, the two statements, either of which may be used, read as follows:

14 CFR 221.103

Public Inspection of Tariffs

All the currently effective passenger tariffs to which this company is a party and all passenger tariff publications which have been issued but are not yet effective are on file in this office, so far as they apply to traffic from or to any point served by this airline. These tariffs may be inspected by any person upon request and without the assignment of any reason for such inspection. The employees of this company on duty in this office will lend assistance in securing information from the tariffs.

In addition, a complete file of all tariffs of this company, with indexes thereof, is maintained and kept available for public inspection at all airline offices.

14 CFR 221.107

Explanation of Contract Terms

All passenger (and/or cargo as applicable) contract terms incorporated into the contract of carriage to which this company is a party are available in this office. These provisions may be inspected by any person upon request and for any reason. The employees of this office will lend assistance in securing information, and explaining any terms.

In addition, a file of all tariffs of this company, with indexes thereof, from which incorporated contract terms may be obtained is maintained and kept available for public inspection at all airline offices.

In addition, airlines may also request to post their Contract of Carriage statement independently of the requirements of 14 CFR 221.103 or 14 CFR 221.107. Or the airline may post their Contract of Carriage statement to meet requirements of 14 CFR 253 Notice of Terms of Contract of Carriage (more on this later). In a common-use airport environment, the goal should be to comply with regulations yet avoid adding extra signs unless specifically required to be posted. An airline Contract of Carriage sign may measure up to 12" w x 12" h. Airport sign managers may need to work out a compromise with airlines for posting of information under 14 CFR 221.

Regarding 14 CFR 253 Notice of Terms of Contract of Carriage:

- Applies to direct air carrier operations in interstate and overseas air transportation
- A ticket or other written instrument that embodies the contract of carriage may incorporate contract terms by reference (i.e., without stating their full text), and if it does so shall contain or be accompanied by notice to the passenger as required by this part (this latter part discussed below)
- Each air carrier shall make the full text of each term that it incorporates by reference in a contract of carriage available for public inspection at each of its airport and city ticket offices.
- This section does not require signs. It only states that the information be made available upon request at the airport or airline offices:

- o "Passengers may inspect the full text of each term incorporated by reference at the carrier's airport or city ticket offices."
- To summarize, the airline must provide information, or reference information for, the Notice of Terms of Contract of Carriage on their ticket. A request by an airline to also post the sign must be weighed against the fact that the same information is already on the ticket.

If there is a need to meet the requirements of an airline that desires to post a notice of contract terms (Passenger Contract of Carriage), one suggested (but not required) sign is as follows:

Notice of Contract/ Incorporated Terms

Air transportation by your airline of choice is subject to the terms of the airline's Passenger Contract of Carriage. You may request to inspect the Contract of Carriage at the ticket counter or obtain a copy by contacting the airline.

Items included in the Passenger Contract of Carriage are restrictions, limits of liability, rules on reservations, rules regarding check-in and boarding times, rules regarding overbooking and lost tickets. For complete details and further information, contact your airline representative.

The signs above should be grouped together with similar signs such as the Passenger Rights messages and on the same panel of messages. One suggested sign, which was entitled Passenger Notices, is below. In this case, the traditional message "Public Inspection of Tariffs" was selected:



Unlawful Discrimination

Message: Unlawful Discrimination

Required by: 49 CFR 21 Appendix C (b)(2)(ii)

Web Link: The electronic Code of Federal Regulations is the preferred website for investigating further these requirements.

- 1) Go to: <http://ecfr.gpoaccess.gov>
- 2) Select Title 49
- 3) Select the appropriate links to the section you want. For example, select Section 21 and then select part Appendix C from the next page of links

Font/ Size: Not specified

Location: Main public area or areas of the airport

Fine Amount: N/A

49 CFR 21 Appendix C (b)(2)(ii) - Obligations of the airport operator/ Notification of beneficiaries states the airport operator shall:

Conspicuously display a sign, or signs, furnished by the FAA, in the main public area or areas of the airport, stating that discrimination based on race, color, or national origin is prohibited on the airport.

There is no information regarding which group in the FAA provides the sign, though it is likely that responsibility belongs to the Area Manager of the FAA Area in which the airport is located.

Regarding content and form, the requirement is brief: "discrimination based on race, color, or national origin is prohibited on the airport." However, the Department of Transportation has this statement regarding civil rights: "The Department of Transportation's civil rights policies strictly prohibit discrimination in its programs, activities and employment on the basis of race, color, national origin, gender, religion, age (40 years and over), disability, or sexual orientation." In this case, the areas of discrimination have been extended beyond race, color, or national origin.

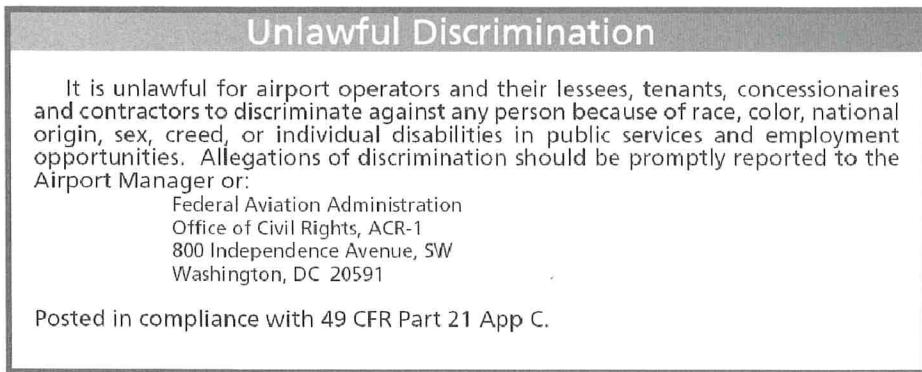
The suggested language for a sign, to meet the requirements 49 CFR 21 Appendix C (b)(2)(ii), and to be aligned with the policy of the Department of Transportation regarding discrimination as well as providing a means to report on what to do with allegations, is as follows:

Unlawful Discrimination

It is unlawful for airport operators and their lessees, tenants, concessionaires, and contractors to discriminate against any person because of race, color, national origin, sex, creed, or

handicap in public services and employment opportunities. Allegations of discrimination should be promptly reported to the Airport Manager or: Federal Aviation Administration Office of Civil Rights, ACR-1 800 Independence Avenue, SW Washington, DC 20591

Example Sign



References

1. A. Churchill et al./Journal of Air Transport Management 14 (2008) 151–158.
2. Andre, A. D. Human Orientation and Wayfinding in Airport Passenger Terminals. *Transportation Research Record*, No. 1298, Transportation Research Board, Washington, D.C., 1991.
3. O'Neill, Michael J. Effects of Signage and Floor Plan Configuration on Wayfinding Accuracy. *Environment and Behavior*, Vol. 23, No. 5, 1991, 553–574.
4. Fewings, Rodney. Wayfinding and Airport Terminal Design. *Journal of Navigation*, Vol. 54, No. 2, 2001.
5. Braaksma, J. P., and W. J. Cook. Human Orientation in Transportation Terminals. *Journal of Transportation Engineering*, Vol. 106, No. 2, 1980, pp. 189–203.
6. Alexander, G. J., and Lunenfeld H. Positive Guidance in Traffic Control. Federal Highway Administration, Washington, DC, April 1975.
7. US Department of Transportation; Federal Highway Administration, Official MUTCD Interpretations Issued by FHWA, <http://mutcd.fhwa.dot.gov/resources/interpretations/index.htm>
8. US Department of Transportation; Federal Highway Administration, Official MUTCD Experimentation Process, <http://mutcd.fhwa.dot.gov/condexper.htm>
9. Hawkins Jr., H. G., A. Stoddard, K. Collins, and C. Weatherby. Identification and Evaluation of Guide Signing for Airport Roadways with Specific Application to the Dallas/Fort Worth International Airport. Texas Transportation Institute. Report No. SWUTC/98/467406-1, 1998. Available at <http://swutctamu.edu/publications/technicalreports/467406-1.pdf>.
10. Wayfinding and Signage Master Plan, Norman Y. Mineta San Jose International Airport, 2004
11. Guide Signs, Part III: List of Control Cities for Use in Guide Signs on Interstate Highways. American Association of State Highway and Transportation Officials, Washington, DC, 2001
12. US Department of Transportation; Federal Highway Administration, Interpretation Letter 2-564(I)-Orientation of Airport Symbol, May 2005, http://mutcd.fhwa.dot.gov/resources/interpretations/2_564.htm
13. McNees, R. W. (1982) In situ study determining lane-maneuvering distance for three- and four-lane freeways for various traffic-volume conditions. *Transportation Research Record*, 869, 37–43
14. American Association of State Highway Transportation Officials (AASHTO) *A Guide to Small Sign Support Hardware*, Single User Digital Publication, 1998. https://bookstore.transportation.org/item_details.aspx?ID=1148
15. American Association of State Highway Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 5th Edition, 2009, https://bookstore.transportation.org/item_details.aspx?ID=1319
16. US Department of Transportation; Federal Highway Administration, *Roadside Hardware Policy and Guidance* http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road.hardware/breakaway/signsupports.cfm
17. American Association of State Highway Transportation Officials (AASHTO) *Roadside Design Guide*, 3rd Edition, 2006, https://bookstore.transportation.org/item_details.aspx?ID=148
18. Crashworthy Work Zone Traffic Control Devices: http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road.hardware/wzd/
19. Crashworthy Approval Process http://www.workzonesafety.org/safety_products/nchrp_350_approval
20. IES RP-19-01 Illuminating Engineering Society, *Roadway Sign Lighting*, March 3, 2001, ISBN: 0879951753. Available at www.ies.org
21. Sign Retroreflectivity Toolkit, FHWA Publication Number FHWA-CFL-TD-09-005 http://safety.fhwa.dot.gov/roadway_dept/night_visib/retrotoolkit/
22. American Association of State Highway and Transportation Officials. 2005. *Roadway Lighting Design Guide*. Washington, DC: American Association of State Highway and Transportation Officials

23. Hildebrand ED. 2003. Reductions in traffic sign retroreflectivity caused by frost and dew. *Transportation Research Record* (1844): 79–85. Transportation Research Board, Washington, DC
24. Paniati, Jeffrey. *Use of Changeable Message Sign (CMS) for Emergency Security Messages*. Policy Memorandum dated March 21, 2003. Available at: <http://www.fhwa.dot.gov/legsregs/directives/policy/securmemo.htm>. Accessed July 31, 2009.
25. Dudek, Conrad L. and Gerald L. Ullman. *Dynamic Message Sign Message Design and Display Manual*. Research Report FHWA/TX-04/0-4023-P3. Texas Transportation Institute, The Texas A&M University System, College Station, Texas, April 2006.
26. *Portable Changeable Message Sign Handbook*. Report No. FHWA-RD-03-066. Federal Highway Administration, U.S. Department of Transportation, Washington, D.C. Available at <http://www.tfhrc.gov/pavement/ltpp/reports/03066/index.htm>. Accessed on December 8, 2009.
27. Dudek, Conrad L. *Guidelines on the Use and Operation of Changeable Message Signs*. Research Report FHWA/TX-92/1232-9. Texas Transportation Institute, The Texas A&M University System, College Station, Texas. November 1992.
28. Ullman, Gerald L., Brooke R. Ullman, Conrad L. Dudek, Nada D. Trout. *Legibility Distances of Smaller Character Light-Emitting Diode (LED) Dynamic Message Signs for Arterial Roadways*. Research Report 404940-1. Texas Transportation Institute, The Texas A&M University System, College Station, Texas, July 2004.
29. Hawkins, H. G., A. Stoddard, K. Collins and C. Weatherby. Identification and Evaluation of Guide Signing for Airport Roadways with Specific Application to the Dallas/Fort Worth International Airport, Southwest University Transportation Center Report 467406-1, July, 1998, Texas A&M University, College Station, TX, <http://swutc.tamu.edu/publications/technicalreports/467406-1.pdf>
30. Boston Logan International Airport Signage Standards and Guidelines, Vol. 3—Parking, August 2005.
31. Monahan, “Parking Structure Signing and Graphics.” *The Parking Professional*, April 1990.
32. The Dimensions of Parking, Urban Land Institute/National Parking Association, 2000.
33. Improving Pedestrian Safety at Unsignalized Crossings (NCHRP 5325), Fitzpatrick, et al., Transportation Research Board. Washington, DC, 2006.
34. “Airport Ground Access Planning Guide”, U.S. Department of Transportation, Research and Innovative Technology Administration, 1995. <http://ntl.bts.gov/DOCS/AGAPP.html>
35. Boston Logan International Airport Signage Standards and Guidelines, Vol. 3—Parking, August 2005.
36. Apple Designs, Inc. Guidelines for Airport Signing and Graphics: Terminals and Landside, 3rd Edition, 2001. <http://www.appledesigns.net/articles/Publication-03/guidelines-index.pdf>
37. USDOT Symbols and Signs, American Institute of Graphic Arts, New York, 1974. <http://www.aiga.org/content.cfm/symbol-signs>
38. Improving Pedestrian Safety at Unsignalized Crossings (NCHRP 5325), Fitzpatrick, et al., Transportation Research Board. Washington, DC, 2006.
39. Carpman, J. and Grant, M. Design That Cares: Planning Health Facilities for Patients and Visitors. J-B AHA Press. 1993.
40. Fewings, Rodney. Wayfinding and Airport Terminal Design. *Journal of Navigation*, Vol. 54, No. 2, 2001.
41. Gunn, Peter. Sign of the Times: Digital Signing is an evolving Area of Terminal Technology. *Airports International*, Vol. 39, No. 8, 2006, pp. 20–21.
42. Bocker, M. A Multiple Index Approach for the Evaluation of Pictograms and Icons. *Computer Standards & Interfaces*. Vol. 18, 1996, pp. 107–115.
43. Comparing Typefaces for Airport Signs—Author: Waller, Robert. Source: *Information Design Journal*, Volume 15, Number 1, 2007
44. Nini, Paul. Typography and the Aging Eye: Typeface Legibility for Older Viewers with Vision Problems. Jan. 23, 2006. Available online at <http://www.aiga.org/content.cfm/typography-and-the-aging-eye>.
45. Garvey, P. M., Donald Meeker, Abduliah Zineddin, Martin Pietrucha, and James Montalbano. A New Font for National Park Service Signs. TRB 2004 Annual Meeting.
46. Gunderson, K. Salt Lake City Department of Airports, Signs and Lighting Dept. Conversation with Jim Harding, Feb. 5, 2010.
47. Jacobson, R. *Information Design*. The MIT Press, June 1999.
48. Federal Aviation Administration (FAA) Advisory Circular 150/5240-18E “Standards for Airport Sign Systems”, September 12, 2008 http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/EF5A930E61E10EE4862574CE004C21CC?OpenDocument&Highlight=signing
49. Federal Aviation Administration (FAA) Advisory Circular 150/5360-12E “Airport Signing and Graphics”, September 18, 2008 http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/EF5A930E61E10EE4862574CE004C21CC?OpenDocument&Highlight=signing
50. International Civil Aviation Organization (ICAO) Document 9636, “International Signs to Provide Guidance to Persons at Airports and Marine Terminals” (1995, Reprinted 2003). Available for purchase at <http://icaodsu.openface.ca/documentItemView.ch2?ID=8010>

51. AASHTO Guidelines for the Selection of Supplemental Guide Signs for Traffic Generators Adjacent to Free-ways, 4th Edition; Guide Signs, Part II: Guidelines for Airport Guide Signing; Guide Signs, Part III: List of Control Cities for Use in Guide Signs on Interstate Highways. AASHTO Bookstore Item # GSGLC-4. https://bookstore.transportation.org/item_details.aspx?ID=122
52. Hunt, M. E. Enhancing a building's imageability. *Journal of Architectural and Planning Research*, Vol. 2 (1985) 151–168.
53. Weisman, G. Improving way-finding and architectural legibility in housing for the elderly. In V. Regnier & J. Pynoos (Eds.) *Housing the aged: Design directives and policy considerations*, New York: Elsevier, 1987.
54. Electronic Code of Federal Regulations: E-CFR™. GPO Access. Available at http://ecfr.gpoaccess.gov/cgi/t/text{text=idx?c=ecfr&tpl=/ecfrbrowse/Title23/23cfr655_main_02.tpl. Accessed May 2, 2011.
55. Schweiger, C. L. TCRP Synthesis 48: Real-Time Bus Arrival Information Systems. Transportation Research Board of the National Academies, Washington, D.C., 2003. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_48.pdf.
56. Dada, E. S. and S. C. Wirasinghe. Development of a New Orientation Index for Airport Terminals. Transportation Research Board. *Transportation Research Record* No. 1662 (1999) 41–47.
57. Braaksma, J. P., and W. J. Cook. Human Orientation in Transportation Terminals. *Journal of Transportation Engineering*, Vol. 106, No. 2, 1980, pp. 189–203.
58. Lam, W. H. K., Mei-ling Tam, S. C. Wong, and S. C. Wirasinghe. Wayfinding in the passenger terminal of Hong Kong International Airport. *Journal of Air Transport Management*, Vol. 9. No. 2 (2003) 73–81.
59. Dada, E. S. and S. C. Wirasinghe. Development of a New Orientation Index for Airport Terminals. Transportation Research Board. *Transportation Research Record* No. 1662 (1999) 41–47.
60. Churchill, Anthony, Ezekiel Dada, Alexandre G. de Barros & S. C. Wirasinghe. Quantifying and validating measure of airport terminal wayfinding. *Journal of Air Transport Management*, 14 (2008) 151–158.
61. ANSI/HFS 100-1988. American National Standard for Human Factors Engineering of Visual Display Terminal Workstations. Human Factors and Ergonomics Society, 1988. Available at <http://www.hfes.org/web/Standards/standards.html>
62. Airport Signage Guidelines, Transportation Security Administration, 2010.
63. Ardit, Aries, PhD. Effective Color Contrast: Designing for People with Partial Sight and Color Deficiencies. Lighthouse International, 2005. Available at <http://www.lighthouse.org/accessibility/design/accessible-print-design/effective-color-contrast>
64. U.S. Department of Transportation, FHWA Policy Memo, March 21, 2003. Use of Changeable Message Sign (CMS) for Emergency Security Messages. Available at <http://www.fhwa.dot.gov/legsregs/directives/policy/securmemo.htm>.
65. FHWA Report No. FHWA-JPO-07-011, *Advanced Parking Management Systems: A Cross-Cutting Study*, Federal Highway Administration, 2007. Available at http://www.its.dot.gov/jpdocs/repts_te/14318.htm.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHTO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI-NA	Airports Council International—North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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